ONTARIO POWER AUTHORITY

5

Supply Mix Submissions and Presentations

Volume 5 – December 2005

Ontario Power Authority

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Supply Mix Submissions and Presentations (Web only)

Volume 5 – December 2005

Volume 5 contains the over 185 submissions and 21 presentations that provided input in the development of OPAs supply mix advice to the Minister of Energy. Submissions were received from individuals, companies, groups and organizations and were discussed in Part 2-3 of the Supply Mix Advice Report. Because in some cases, several parties submitted joint submissions, single parties submitted multiple submissions, or others requested that their advice not be posted, the submissions and presentations listed below may not match exactly with the list provided in Part 2-3.

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Electricity Supply Mix for Ontario

A written submission to the

Ontario Power Authority

Submitted by

Durham Strategic Energy Alliance (DSEA)

August 2005

Recommendations:

The DSEA recommends that OPA considers the following measures in its planning for future supply mix:

1. To **build new large scale generating power stations** that could realistically and readily meet increasing electricity demands and benefit from existing technology and asset-base in Durham;
2. Given its strong mix of energy providers and knowledge base, to **work closely with members of the Durham Strategic Energy Alliance** in analyzing present and future options and opportunities;
3. To **commission an in-depth study** to analytically assess the different supply technologies in Ontario using historical and current data on actual performance, technology life cycle, operating costs and performance;
4. To implement efficient means of **demand-side management** to shift peak demand to off-peak hours; and
5. To steadily increase implementation of **renewable energy** production and **conservation measures** to provide relief on the demand side.

==========

Background:

The province of Ontario is facing significant challenges in coming years in order to ensure that enough electricity supply is available to its growing population base. Add to the current challenges, the province plans to remove coal-fired electricity generation from its supply capacity, and demand is expected to rise by 0.9% per year. Although plans have been announced for substitutes for coal, the replacements only account for roughly half of the capacity provided by coal.

In order to deal with such significant challenges, the province needs to employ a strategic plan to create new generating capacity. Beyond that, consumers need to make significant efforts to conserve energy. Major conservation efforts will allow for sufficient time to create further generation since a large generating station typically takes up to 10 years from concept to completion.

Ontario Energy Outlook:

Ontario had a relatively reliable electricity supply in past years. Current generating capacity is upwards of 30,000 MW (if all reserve generation is taken into account). All-time peak demand has been measured to be 26,160 MW (on

July 13, 2005). The outlook for the future electricity supply in Ontario is not good, however. With the province's announcement of its plan to permanently remove coal-fired generation from its energy generation mix, and with the steadily increasing consumer's demand, the province is facing significant challenges to meet the demand in coming years.

The province currently operates four coal-fired generating stations which contribute approximately 6,400 MW (a total of 21.4% of the province's generating capacity). The remainder of the electricity generation mix in Ontario is as follows[1]:

- Nuclear: 36.1%
- Hydroelectric: 25.8%
- Oil/gas: 16.5%
- Others: 0.2%

The removal of coal from the generation mix represents a problem since coal constitutes about 21.4% of the generation capacity. Under the coal replacement plan unveiled by the province in early 2005, four of the five coal-fired stations in Ontario will be closed by the end of 2007. The plan has already been set in motion with the closure of the Lakeview Generating Station (1,140 MW) in Mississauga in April 2005. Under the plan, the following changes will be made:

- Thunder Bay Generating Station (310 MW) will be replaced by gas-fired generation by the end of 2007;
- Atikokan Generating Station (215 MW) will close by the end of 2007 following the retrofits to Thunder Bay GS, and various transmission system upgrades;
- Lambton Generating Station (1,975 MW) will be replaced by two combined-cycle gas-fired generating stations by the end of 2007; and
- Nanticoke Generating Station (3,938 MW) will progressively shut down its units through 2008, with the final shutdown scheduled for early in 2009.

Figure 1 shows the prediction of supply and demand as published by the Independent Electricity System Operator (IESO). Under the trends outlined in the figure, demand may exceed supply as quickly as mid-2007. If effective conservation efforts are implemented, and planned generation additions are brought online, a daunting supply shortage would only be delayed until 2013.

Large-scale electricity generation projects can take up to 10 years to complete.

Natural gas and coal-fired generation stations have the advantage of being able to manage demand shifts very well. During peak demand more units are turned on and during off peak hours the generators remain inactive. This allows the supply curve to closely match the demand curve throughout the day. The province will need a better means of controlling the supply-demand curve throughout the day.

[1] Source: "10 Year Outlook: An Assessment of the Adequacy of Generation & Transmission Facilities to Meet Future Electricity Needs in Ontario" – Independent Electricity System Operator (IESO)

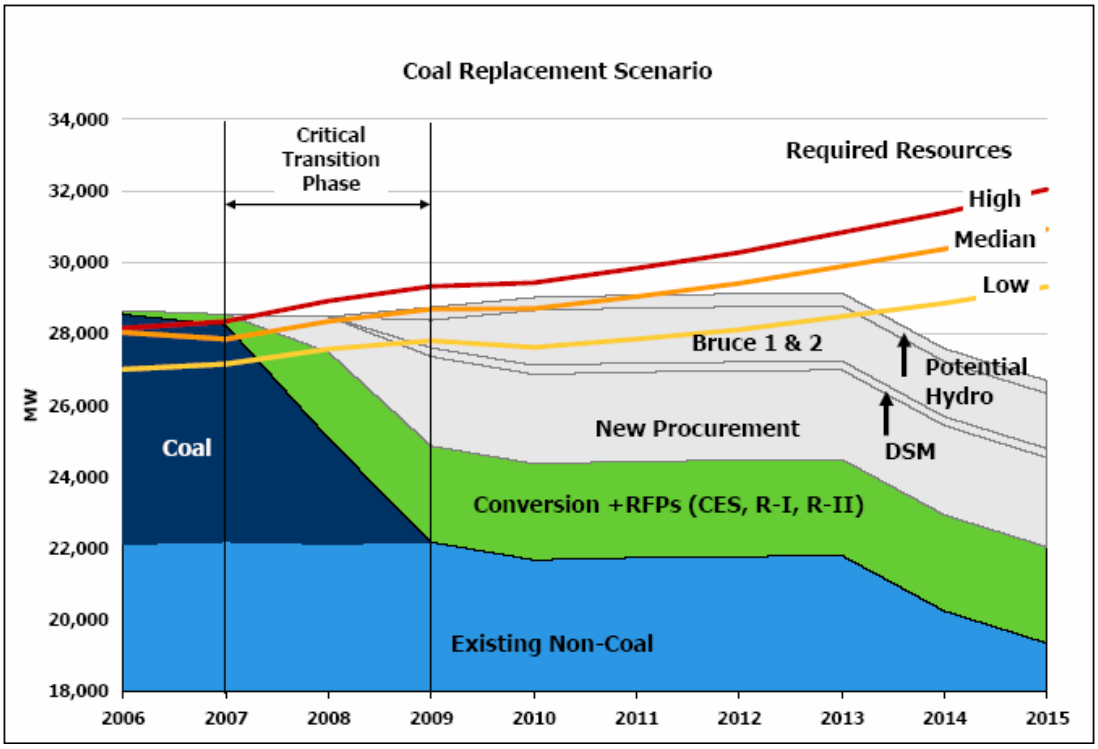

Figure 1: Energy Outlook Considering Coal-Replacement

Source: "10 Year Outlook: An Assessment of the Adequacy of Generation & Transmission Facilities to Meet Future Electricity Needs in Ontario" – Independent Electricity System Operator (IESO)

In the grand scheme of Ontario's energy outlook for future, additional generation will be required beyond current plans. Large-scale electricity generation projects (such as large-hydro, nuclear, coal gasification stations, etc.) can take up to 10 years to complete all stages including financing, design, regulatory and environmental approvals, construction and commissioning. **As a result, decisions are urgently needed for the creation of additional supply.**

Major conservation efforts will allow for sufficient time to create further generation capacity to meet daunting future electricity needs

In the mean time, conservation will play an important role in ensuring that Ontario has a secure electricity supply. The implementation of demand-side management to flatten demand curves throughout the day should be an important aspect of a conservation strategy. Finally, the province needs to be engaged in a multi-prong approach that includes the development of baseload power stations in addition to major conservation efforts.

Acknowledgments:

The DSEA wishes to acknowledge the contribution of its UOIT member, Dr. Kamiel Gabriel and his summer student research assistant, Mr. Samveg Saxena in providing the summary of data and analysis included in this paper.

Subject: Power supply mix

To whom it may concern:

This submission is in regards to power supply mix for the province of Ontario.
In my opinion Ontario requires affordable and competitively priced electricity for it's businesses and people.
In order to achieve that:
- Ontario should be self sufficient for electricity supply.
- all forms of clean energy, including clean coal, coal gasification and nuclear should be part of the provinces energy mix so Ontario isn't overly dependent on any one energy source and vulnerable to dramatic price increases of a single energy source.
- renewable have a role to play but their contribution should be realistic, used only in case of power shortage and cost must be considered.
- diverse energy sources are required to provide reliable supply.
- I don't believe smart meters will reduce the consumption of electricity and that education programs would be more effective to change consumption habits in order to reduce peak demands in the province. I also believe that “smart” meters are intimidating, limiting and violate people’s freedom to be able to use electricity whenever necessary and not only when affordable.
Thank you.

Henryk Dziedzic

Phone & Fax No.
(705) 745-7127
e-mail address
royjoyedwards@sympatico.ca

619 Walkerfield Avenue
PETERBOROUGH ON
CANADA K9J 4V9

August 18, 2005.

Ontario Power Authority
Supply Mix Submissions
175 Bloor St E., North Tower, Suite 606
TORONTO ON
M4W 3R8

AUG 2 3 2005

Dear Sirs,

This letter is sent in response to your newspaper announcement that appeared in the Toronto Star of July 13, 2005.

Firstly, let me make it clear that I have no connection of any sort with any commercial or industrial undertaking. I am a retired ecologist and spent much of my career studying the flow of energy through natural ecosystems. This inevitably led me to a study of the energy flow through the human ecosystem. My interest in this topic is therefore purely academic.

At the present time, Ontario is facing two problems – an excess of garbage and a shortage of electrical energy. Our 'solution' to the first problem is to bury the garbage in an Ontario landfill site or truck it to the U.S.A. for burial in a Michigan landfill site. Since the garbage contains a great deal of useable energy, not only are we exporting a valuable energy resource, but we are also wasting a great deal of additional energy just to get it there. Ontario's current 'solution' to the garbage problem is therefore not a solution at all. It is just a double waste of energy.

The most efficient way to deal with the double problem is to convert the energy in the garbage into electrical energy by means of an energy-from-waste plant. This procedure has been in use by many countries for at least 25 years. The technology has been upgraded and refined over the years to the point where it is totally reliable, economically sound, and far less polluting than any other method that is currently in use. The only stumbling block to its adoption in Ontario appears to be a political one, bolstered by misinformation by those who oppose its use. Those who condemn the concept of an EFW plant often seem to be unaware that there is already one in operation in Ontario and another in Vancouver. Both function very efficiently and complaints about them are minimal.

The purpose of this letter, therefore, is to urge you not to pour millions of dollars of taxpayer's money (MY money) into virtually untried schemes, but to use it instead to view some of the EFW plants that exist throughout the world. In that way you can learn, from those who have had experience of them, what they think of them.

Yours sincerely,

Roy L. Edwards M.A. D.Phil (Oxon)
Professor Emeritus & Ecologist.

Phone & Fax No.
(705) 745-7127
e-mail address
royjoyedwards@sympatico.ca

619 Walkerfield Avenue
PETERBOROUGH ON
CANADA K9J 4V9

August 18, 2005.

Ontario Power Authority
Supply Mix Submissions
175 Bloor St E., North Tower, Suite 606
TORONTO ON
M4W 3R8

AUG 2 3 2005

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Yours sincerely,

Roy L. Edwards M.A. D.Phil (Oxon)
Professor Emeritus & Ecologist.

Dear Minister:
I would like to request that the government consider increasing the renewable energy portfolio beyond what has been planned so far.
With greater emphasis on renewables, it should be possible to reduce coal use to backup only.
Ontario has a fantastic wind resource, but lags behind most other developed countries in wind generating capacity, as we have invested heavily in nuclear technology, which is not proving cost effective.

If you would allow applications from small community based projects this may help increase the renewable supply.

Sincerely

****

Dr. Richard Ehrlich
Caledon Clean Air Clean Energy Project

EDA

The Voice Of Ontario's Electricity Distributors

October 26, 2005

Mr. Amir Shalaby
Vice-President, Power System Planning
Ontario Power Authority
175 Bloor Street East
North Tower, Suite 606
Toronto, Ontario M4W 3R8

Dear Mr. Shalaby:

Re: EDA supplementary comments on EDA submission of October 4 on Supply Mix

The Electricity Distributors Association (EDA) would like to provide some supplementary comments on the EDA submission on Supply Mix issues given on October 4th.

During the EDA presentation the OPA asked the EDA to provide additional details on what incentives or assistance could be provided to distributors to facilitate the connection of renewable generation. The EDA met with members on October 20th to discuss this issue. Many distributors attended the Operations Council meeting.

The members at the Council meeting suggested that OPA should consider ways to assist distributors in addressing their operational tasks to connect embedded generation. The Distribution System Code requires distributors to respond to applications for generation connections within 60 or 90 days, regardless of the number of applications pending. Many distributors do not have the expertise or resources to respond to these applications in the allowed timeframes. Distributors would like templates and standard generic agreements to facilitate the applications process and provide guidance on what should be considered in an agreement. Technical guides could assist distributors in ensuring the requirements for connecting, protecting the distribution system and meeting safety requirements are achieved while also considering the cost to the generation owner.

Members did not support subsidizing the connection of renewable generation through distribution rates. Members suggested that if connection costs are to be subsidized to support renewable generation, they should be through the OPA to ensure the costs for the connection of renewable generation were borne by all those who would benefit from the renewable generation. The members believed subsidies for connection should be limited to a certain percentage to allow some price signals to encourage generation to locate in areas that would have lower connection costs.

Electricity Distributors Association
3700 Steeles Avenue West, Suite 1100, Vaughan, Ontario L4L 8K8 Tel 905.265.5300 1.800.668.9979 Fax 905.265.5301 email@eda-on.ca www.eda-on.ca

Members suggested that to encourage renewable generation, the OPA should consider subsidizing economic feasibility studies for renewable generation at different locations across the province. Distribution connection studies could also be subsidized by the OPA to reduce the risk to generation developers concerned about incurring costs and then not being able to proceed.

The EDA would also like to provide supplementary comments on what the OPA can do to assist CDM programs. The EDA has asked the OPA to provide templates of programs that could be used by distributors. The OEB's Total Resource Guide contains an assumptions and measures list that could be used by distributors in their TRC analysis for post program evaluation. This list would be more useful if more details were provided on the overall design of each of the programs to allow distributors to design similar programs, thus reducing concerns that the default values in the list are not applicable.

The EDA looks forward to the OPA's response to the EDA proposals.

Yours truly,

Maurice Tucci

Maurice Tucci
Senior Analyst

MT:lm

Electricity Distributors Association
3700 Steeles Avenue West, Suite 1100, Vaughan, Ontario L4L 8K8 Tel 905.265.5300 1.800.668.9979 Fax 905.265.5301 email@eda-on.ca www.eda-on

August 29, 2005

Via E-Mail

Mr. Paul Bradley
Vice President - Generation Development
The Ontario Power Authority
175 Bloor Street East
North Tower, Suite 606
Toronto, Ontario
M4W 3R8
Paul.Bradley@powerauthority.on.ca

Re: EMIG Response to OPA Consultations on Supply Mix

EMIG believes the objective of Ontario's long-term plan for electricity should be to specify the steps necessary to ensure that the electricity system operates at an acceptable level of reliability, while meeting the future needs of Ontario consumers for clean competitively priced electricity.

The reliability of the electricity system is based, among other factors, on having adequate well-maintained generation resources, a reasonable diversity of generation sources both in technology and location, access to imports from adjacent regions, and a reliable transmission system. Of these factors, resource adequacy and diversity are directly linked to the question of the appropriate supply mix.

While EMIG recognizes, and supports, the usefulness of defining a desired supply mix, we continue to believe that the government's objective, reflected in the structure put in place under Bill 100, is to transition away from central control and move towards a market based mechanism for ensuring a reliable and reasonably priced supply of electricity. The economic incentives inherent in market-based generation investment assure efficient allocation of capital and high availability and efficiency, thus assuring the most economic means to meeting Ontario's supply needs. While the goal of supply diversity may be an important long-term risk mitigant, care must be taken that inducements for supply resources that are not expected to arise through market means do not discourage or preclude the long-term development of market-based investment. Where it is determined that out-of-market generation or demand-side initiatives are nonetheless required to achieve resource diversity objectives, they should rely to the extent practicable on the benefits of private-sector participation and be structured

so as to be compatible with the development of a viable competitive marketplace that is ultimately better equipped to efficiently value and mitigate long-term risks.

EMIG's primary concern is that a centralized supply mix plan is inherently at odds with competitive electricity market forces. As such, we believe that the following issues must be given serious consideration in the contemplation of the development of supply mix policy:

- The OPA should thoroughly evaluate the potential of creating the proper conditions through centralized planning to allow for a market-based response in order to achieve supply mix goals. A by-product of this plan should be a diminishing role for the OPA in determining the supply mix.

- Supply mix targets need to be economically sound on a full cost evaluated basis. A framework for identifying new supply sources for planning purposes needs to be developed, and should properly identify all costs and risks, and take into consideration the related environmental policy objectives. The OPA should be, as much as possible, technology neutral and select new generation development on the basis of expected reliability, overall cost (including environmental costs and other externalities), experience and capability of the developer, and fit with the long-term plan (timing, location). This framework needs to carefully balance economics and environmental considerations.

- The OPA should identify and adopt potential contracting structures that are consistent with the goal of phasing out the OPA's role, support investment in new generation, and minimize the potential of negative effects on the competitive market. In the case of large, long lead-time developments such as new nuclear developments, the OPA should investigate contracting structures and support mechanisms that minimize distortions of the competitive market and do not create competitive imbalances between nuclear and other forms of generation.

- The OPA should identify barriers to the efficient and timely development of "clean" generation technologies. Where barriers exist, the OPA should work with the appropriate agencies to remove or reduce the barriers.

- Imported or exported energy should not be included in any assessment of supply adequacy. Imports and exports of electricity should participate in Ontario's competitive electricity market on an equal footing with Ontario supplies, i.e. imports and exports should be allowed to set price.

- Supply mix policy should mandate a degree of supply diversity in order to avoid over reliance on a technology or fuel type (i.e. set maximum limits on any particular technology).

- Renewable policies must have sound economic basis derived from proper consideration of externalities (i.e. emissions and nuclear risk), and should be implemented without distorting the market**.** To the extent the avoided externality benefits of renewables are not monetized through other market mechanisms, the plan should include imposing a renewable standard (i.e. requiring renewables to be a certain percentage of a consumption portfolio), which is ultimately transferred from the OPA to consumers or designates. In general, supply mix policy needs to carefully consider how the renewables might be integrated into the competitive market, and avoid future NUG-like contracts whereby renewable energy would effectively be added to the non-market pool.

- The role of CDM needs to carefully considered, and subject to the same degree of economic rigour as are generation technologies. CDM savings must become imbedded and goals must be measured year over year in order to determine their success

- The OPA's central planning needs to be transparent, particularly with respect to new nuclear development or other large mandated generation developments, (i.e., Conawapa or Churchill Falls). Uncertainty in this respect will cause developers to postpone investments in new generation as they will be concerned about competing with subsidized generation investment. Or, those developers who have already proceeded may end up earning an inadequate return on their investment if subsidized generation subsequently emerges.

- All cost premiums associated with satisfying supply mix objectives (e.g., renewables) must be incorporated into the competitive side of the market and not simply rolled-in to the uplift side.

Supply mix policy needs to consider how transmission system upgrades will be coordinated with new investments in generation. Transmission upgrade costs need to be included in the full evaluated costs of supply mix decisions that may have locational implications.

Yours truly,

Robert G. Power
On behalf of EMIG

RGPP:wif

Electro-federation Canada (EFC) represents manufacturers and distributors of electrical equipment. We devoted our April Annual General Meeting to issues surrounding electricity supply in Canada; MP Donna Cansfield and Jan Carr of OPA were amongst our speakers. The scope of forecast investment in Power Generation, Transmission and Distribution in Canada, The US and globally over the next number of years is such that in order to assure availability of electrical products necessary for the construction of energy assets coordination between suppliers and consumers of these products becomes of paramount importance.

While OPA signs electricity contracts, the mix and the timing of these contracts can be one of the demand predictors for products. For example we can estimate product requirements by the various modes of power generation, location of the power plants etc. Therefore, we would very much like to be kept in the loop as these policy decisions evolve.

Best regards

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Milos Jancik
President & CEO
ELECTRO - FEDERATION CANADA
Phone: (905) 602-8877 ext. 227
Fax: (905) 602-5686
Email: mjancik@electrofed.com
Web: www.electrofed.com
Mail: 5800 Explorer drive, Suite 200
Mississauga, ON L4W 5K9

August 26, 2005

Ontario Power Authority
Supply Mix Submissions
175 Bloor St. E., North Tower, Suite 606
Toronto, ON

To Whom It May Concern:,

eMeter Corporation is pleased to provide comments to the Ontario Power Authority per the request for comments dated July 13, 2005. Our comments provide experiential information pertinent to the second of the issues listed in the request for comments, specifically "experience in implementation of CDM and technology developments."

Market Research Results – California Statewide Pricing Pilot
The first area to which we draw OPA's attention is the California Statewide Pricing Pilot. The SPP was conducted in 2003 and 2004 throughout California and consisted of testing of critical peak pricing and time-of-use pricing.

The SPP's grounded, scientific methodology has very specific data on which to base policy recommendations. Extensive market research was conducted by Momentum Corporation and summarized in a report ("Report") to the California Public Utilities Commission in March 2004. Here are some examples of data underlying executive summary findings:

- On a scale of 1 to 10, the average residential customer satisfaction rating was 7.8, with 41 percent of customers rating the program a 9 or 10. (Report at p. 22)
- The average commercial customer rating was 7.0, with 27 percent rating the program a 9 or 10. (p. 23)
- Seventy-eight percent of residential and 70 percent of commercial customers would prefer to stay on the SPP rate rather than return to their old rate. (pp. 24-25)
- Eighty-eight percent of residential and 92 percent of commercial customers said the SPP rates should "definitely" or "probably" be offered to other customers. (pp. 28-29)
- Forty-four percent of residential and commercial customers said the "main advantage" of the SPP rates relates to saving energy, specifically "saving energy," "control use," or "make me aware of energy conservation." (p. 31)

- On average, 85 percent of residential and 54 percent of commercial customers reported making at least one change in energy use because of the SPP rates. (pp. 33 and 39)

- When asked about the difficulty of making changes in energy use, residential customers said the changes were "easy," on average, 76 percent of the time, and commercial customers 87 percent of the time. (pp. 35 and 41)

- When asked whether the changes in energy use could be made permanent, residential customers said "yes," on average, 88 percent of the time, and commercial customers 96 percent of the time. (pp. 35 and 41)

- Regarding residential customer understanding, 86 percent knew that their prices differed by time of day and 73 percent knew that their prices differed by the amount used (since baseline tiers are included in the SPP rates). (p. 82)

- Regarding commercial customer understanding, only 53 percent knew that their prices differed by time of day, and 73 percent *incorrectly* believed that their prices differed by the amount used (there are no baseline tiers in commercial rates). (p. 83)

- Fifteen percent of residential and 14 percent of commercial customers visited the project website; 21 percent of residential and 15 percent of commercial customers called the project phone center. (pp. 99 and 101)

- Eighty-eight percent of both residential and commercial customers rated their satisfaction with the new meter installation process at seven or higher on a scale of 1-10. (pp. 120 and 122)

California's SPP Market Research Results are Consistent with the Literature

The Report's statistical methodology and scientific survey methods are testament to its reliability. In addition, the findings are consistent with market research findings regarding other pilots and programs, such as the following:

- Ninety-seven percent of participants in Central and South West's residential critical peak pricing program preferred the program over their previous rate.[1]).

- Ninety-six percent of participants in Gulf Power's residential critical peak pricing program expressed satisfaction with the program.[2]

- Ninety-five percent of participants in American Electric Power's five-state residential critical peak pricing pilot were satisfied.[3]

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[1] - Hartway, R. *et. al,* "Smart Meter, Customer Choice and Profitable Time-of-Use Rate Option," Energy 24 (1999).

[2] - Neyman, M. and F. Magnotti, "Price Responsive Load Management," Presentation by Gulf Power Company, September 2002.

[3] - Turrell, J. "AEP Uses Technology, Variable Prices to Lower Peaks," Electric Light & Power, April 1994.

California's SPP Found Significant Load Reductions in Response to Pricing Signals
The SPP design may be summarized as follows:

- A two-year Statewide Pricing Pilot (SPP) was proposed in 2003 by California's investor owned utilities and approved by the California Public Utility Commission and California Energy Commission. The SPP was designed to estimate and compare customer energy and load impacts for residential and small commercial customers placed on time differentiated rates. The experiment was also designed to evaluate the impacts of automated control equipment (controllable thermostats) and several customer information treatments.\

- The SPP included a statistically drawn stratified sample of 2,500 residential and small commercial customers (<200kW peak demand) representative of the Pacific Gas & Electric, San Diego Gas & Electric and Southern California Edison service territories. Interval meters were installed on each customer (control and test participant) to support the billing and evaluation functions and to provide customers with access to their usage data. Customers were assigned to either a TOU, Critical Peak Price (CPP), with fixed or variable length critical peak charge, or kept on their original rate to serve as a control.

- CPP rates were designed to be revenue neutral and to maintain bill neutrality for average customers, assuming no change in usage pattern. CPP events were dispatched up to 12 times each summer (a super peak day) and 3 times each winter (2:00 to 7:00 PM).Customers on the variable length CPP rate (CPP-V) were given the option of having controllable thermostats, hot water heater or pool pump controls installed to automatically reduce energy usage in response to peak price signals.

- Customers were exposed to these experimental rates for two summers and two winters over an 18-month period and then given the chance to stay on the rate. Over 60% chose to stay on the new rates.

Key Results of the SPP
The most important results of the SPP were as follows:

- Residential- On super peak days, average peak period reductions of 13 to 16% were estimated for customers without controls; and 16% to 27% reductions for customers with automatic controls.

- Small Commercial- On super peak days, average peak load reductions ranged from 6% to 9% for customers without controls and 14 % to 18% for customers with automatic controls

- Estimated price elasticity of substitution varied from -.04 to -.13 using peak electricity price increases ranging from 3x to 6x (CPP rate to off peak price ratio)

- Higher initial electricity usage, hotter climates and more appliances in the home led to proportionately higher levels of peak reductions.

- Higher percentage savings were achieved by residential customers (relative to small commercial sample) in response to CPP rates.

- A segment of the pilot group received enhanced information on their options to shift usage and its environmental consequences. This did not noticeably enhance peak savings but did prompt noticeable additional investments in long-term efficiency options to reduce peak load every day, not just peak days.

- Inertia is the governing factor for customer rate choice- 20 to 30% would opt in to dynamic pricing vs 60 to 70% would choose to stay with dynamic rates if these were the new default rate; leads to significant differences in expected peak savings for opt-in vs opt-out rate scenarios in residential class.

- Customers want more rate choices now- 91% of customers who participated in 18 month pilot overwhelmingly support offering dynamic rates to all customers and a majority 64% recommend that CPP rates be the new default rate for all customers.

A Major Goal of the SPP was to Measure Price Elasticity

Standard economic theory holds that customers react to changes in prices that they see by adjusting their demand for the good in question. As prices rise, customers reduce the quantity demanded. As prices drop, customers increase the quantity demanded. The responsiveness of customers to price changes is called their *price elasticity of demand*. One measurement of elasticity is the customer's change in consumption in the same time period in which the price change occurs. Another measurement is the customer's shift in consumption across time periods – such as peak to off-peak – in response to price changes that alter the price relationship between the two time periods (for example, changing the price ratio from 1:1 to 2:1). These two measurements are called the *own price elasticity* and *elasticity of substitution*, respectively.

Own price elasticity: Analyses of residential customer response to pricing have involved estimating both the magnitude of customer load changes and the value of elasticity parameters that characterize customers' degree of price responsiveness. The *own price elasticity* is simply the percentage change in consumption due to a percentage change in price in either the peak or off-peak time period. For example, if the price doubles – an increase of 100% – and usage declines by 30%, then the own-price elasticity equals (–30%)/ 100%, or –0.30. Note that elasticities are expressed as fractions and have no units.

Elasticity of Substitution: Many analyses have focused on a single parameter that characterizes customers' load shifting from one time period to another (*e.g.,* from the peak to off-peak period). Known as the *elasticity of substitution*, this is the primary parameter of the

constant elasticity of substitution (CES) demand model[4]. The elasticity of substitution represents the negative of the percentage change in the ratio of electricity *consumption* in two time periods that occurs in response to a given percentage change in the relative *price* between those two periods. For example, in the case of a time-of-use rate, the peak to off-peak elasticity of substitution represents the negative of the percentage change in the ratio of *peak to off-peak usage* that occurs in response to a given change in the ratio of *peak to off-peak prices*, all other factors held constant:

$$\sigma = - [\% \Delta (Q_p/Q_o)] / [\% \Delta (P_p/P_o)],$$

where σ is the elasticity of substitution, Q_p and Q_o are peak and off-peak usage, and P_p and P_o are peak and off-peak prices, respectively. A σ value of 0.10 implies that a peak to off-peak price ratio of 150% (*e.g.*, with peak and off-peak prices of $0.25 and $0.10/kWh respectively, and calculating the percent change as the natural logarithm of the price ratio) will produce a reduction in peak to off-peak usage of 15% relative to the case for a flat price (*i.e.*, -0.10 * 150% = -15%).

Own-price elasticities and substitution elasticities may be compared when the necessary data are available. Caves and Christensen (1980) showed that an elasticity of substitution of 0.17 was consistent with a peak-period own-price elasticity of approximately –0.30.

Historical Data on Price Response are Consistent with the SPP Results

Numerous studies of price elasticity in the electric industry have been published. They include analyses based on a wide variety of rates structures: average, declining block, inverted tier, demand, and – most of the studies – time-varying prices (time-of-use, and dispatchable critical peak prices[5]). This literature provides historical background data that are consistent with the findings of the SPP.

In 1984, Jan Acton and Rolla Park reviewed 34 published studies of residential electricity use drawn from North America. Acton and Park estimated overall "short-run" and "long-run" elasticities with respect to electricity. "Short-run" is a period in which consumers make no changes in appliance holdings to respond to price changes, while "long-run" is a time long enough to make changes in appliance holdings. Acton and Park summarized their findings as shown in Table 1, with "low" and "high" bracketing the 80 percent confidence band.

TABLE 1: Range of Estimates of Residential Price Elasticities of Demand

The Low and High Values Bracket the 80 Percent Confidence Band

[4] For a fuller description of this methodology see Braithwait (2001). The explanation of elasticity of substitution has been borrowed from this material.

[5] Critical peak rates generally have peak and off-peak prices in effect most days of the year, with critical peak prices dispatched, usually on a day –ahead basis, for 10 to 20 critical peak days per year.

Short-Run			*Long-Run*		
Low	Medium	High	Low	Medium	High
-0.12	-0.20	-0.35	-0.60	-0.90	-1.20

Source: Acton and Park (1984).

Fifty-six papers published since 1980 expanded on earlier studies by utilizing additional methodologies for analyzing price response and by examining the effects of additional rate structures, such as critical peak prices. Four studies included automated thermostat controls.

TABLE 2: Summary Statistics for 56 Elasticity Analyses

The Low and High Values Bracket the 95 Percent Confidence Band

Geography	*n*	*Short-Run Elasticity*[6]		
		Low	*Medium*	*High*
California	13	-0.13	-0.21	-0.28
U.S.	36	-0.23	-0.28	-0.34
Other industrialized countries.[7]	7	-0.28	-0.47	-0.66

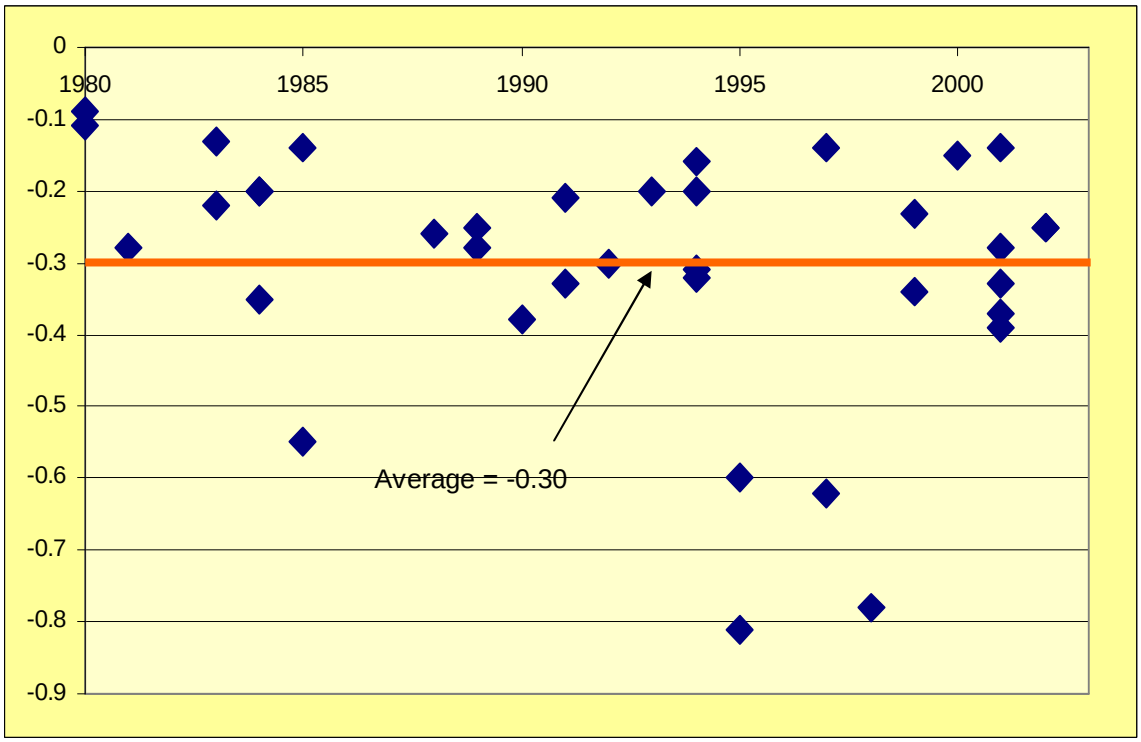
Source: a complete bibliography is available on request.

Of the 56 papers, 36 reported own-price elasticity estimates, as shown in Figure 1.

[6] Own price elasticity estimates are summarized here only.
[7] Canada, the U.K., France, Switzerland, and Denmark.

FIGURE 1: Elasticities in 36 Studies Published Between 1980 and 2003 Show an Average Reduction in Usage of 30% for Every 100% Increase in Price

Are the high outliers misestimated – or do they represent added potential?



Several researchers have looked at the transferability of elasticity estimates from one geographical area to another, including Caves, Christensen, and Herriges (1983). Caves *et al.* use a modeling approach in the spirit of a hybrid demand system. The key price effects are estimated as an elasticity of substitution between peak and off-peak periods. Table 3 shows the model results when applied to data collected in five residential time-of-use experiments.

TABLE 3: Residential Response to Time-of-Use Rates Across Several Experiments Calculated as Substitution Elasticities

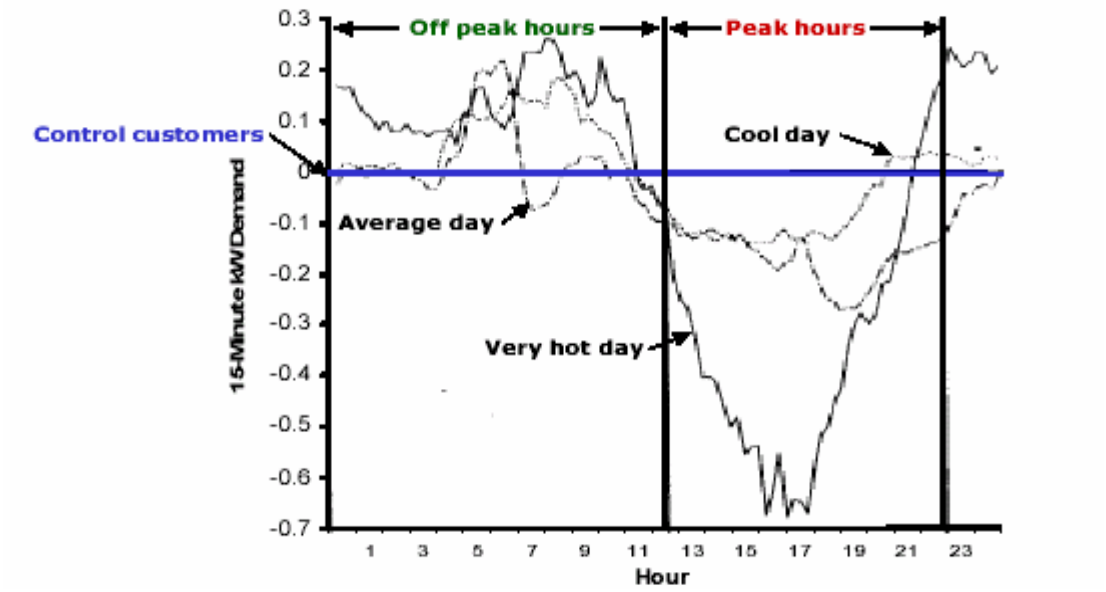
Experiment	*Estimate of Elasticity of Substitution*
Carolina Power & Light	0.19
Connecticut	0.10
Los Angeles 1	0.19
Los Angeles 2	0.16
Los Angeles 3	0.13
Los Angeles 4	0.10
Los Angeles 5	0.13
Los Angeles 6	0.12
Los Angeles 7	0.11
SCE 1	0.14
SCE 2	0.16
Wisconsin 1	0.13
Wisconsin 2	0.13
Wisconsin 3	0.13
Pooled Estimate	**0.13**

Source: Caves, Christensen, and Herriges (1983).

Other researchers have looked at how price response for a time-of-use or critical peak pricing program varies when weather becomes more extreme. Aigner and Lillard (1984) found that time-of-use customers behave in a similar fashion on system peak days as on average summer weekdays and often reduce peak load even more on system peak days (Figure 2).

FIGURE 2: Relative Response of Residential Time-of-Use Customers is Higher on the Hottest Days (graph shows residual between treatment and controls)

Does more load turned on mean more load to turn off?



Source: Aigner and Lillard (1984)

Voluntary versus Mandatory Programs

California's SPP was a voluntary program. At least two groups of researchers have looked at whether volunteers in time-of-use programs self-select into the program because they tend to have more off-peak consumption and, therefore, receive discounts (from lower off-peak prices) without shifting any additional load from peak to off-peak hours. Some observers call such customers "free riders," while others say such customers "are finally being relieved of the burden of subsidizing peakier (free riding) customers."[8]

Baladi, Herriges, and Sweeney (1994) found that the initial decision of residential customers to volunteer for Midwest Power Systems' (MWP's) TOU tariff was found to be largely unrelated to any observable pattern in the household's electricity usage or appliance ownership. Volunteers and non-volunteers were virtually indistinguishable in terms of both their total kWh consumption and its distribution between the on-peak and off-peak pricing periods.

Further, like customers who were automatically placed on TOU rates in other programs, participants in MWP's voluntary TOU tariff were found to significantly reduce their on-peak usage (by roughly 24 percent during the first summer season). Just as Aigner and Lillard found in their analysis, the MWP changes were larger on days when the system peaked, with on-peak usage dropping by over 28 percent. In addition, at MWP, the reductions in on-peak kWh were not concentrated in any one on-peak hour, but were distributed proportionately throughout the on-peak period. Off-peak usage changes also tended to be proportional, with

[8] - Comments of the California Office of Ratepayer Advocates in Rulemaking 02-06-001, April 28, 2003.

the exception that households tended to avoid shifting usage to those hours immediately adjacent to the on-peak period (i.e., shoulder hours). This latter result alleviated the concern that the TOU rates might create a secondary needle peak just outside of the on-peak hours.

Caves, Herriges, and Kuester (1989) reported similar results for Pacific Gas and Electric's voluntary TOU program.

Customers Respond in Different Ways to Dynamic Electricity Pricing

Several researchers have found that the strength of a customer's response will depend on total consumption, appliance holdings, weather, and other socio-demographic factors. For example, the MWP study found that the ability/willingness of individual households to respond to the TOU tariff was significantly influenced by their ownership of major electrical appliances, such as dishwashers, central air conditioners, and dehumidifiers; having more appliances meant a higher percentage reduction in on-peak kWh induced by TOU pricing.

Reiss and White (2001) performed an extensive, statewide analysis on California households, estimating their model results using data from the Department of Energy's *Residential Energy Consumption Survey* (RECS)[9]. As Baladi *et al.* found at MWP, Reiss and White determined that households with electric space heating or air conditioning exhibit a much higher electricity price elasticity than households without such systems, as seen in Table 4.

TABLE 4: Price Elasticities for California Households as a Function of Appliance Holdings

Segment	*Estimate of Price Elasticity*
All households	-0.39
Households with:	
Electric space heating	-1.02
No electric space heating	-0.20
Central or room air conditioning	-0.64
No air conditioning	-0.20

[9] The RECS is conducted every three to four years by the U.S. Department of Energy to collect information on household appliances and energy use. The survey is a nationally representative probability sample of households, with representative subsamples for several large states. The study used the California subsamples of the 1993 and 1997 survey waves, which were the most recent available. Together they provide information on 1,307 California households.

No electric space heating nor air conditioning	-0.08

Source: Reiss and White (2001)

Reiss and White also looked at how price elasticities varied as a function of income, as shown in Table 5.

TABLE 5: Price Elasticities for California Households as a Function of Income

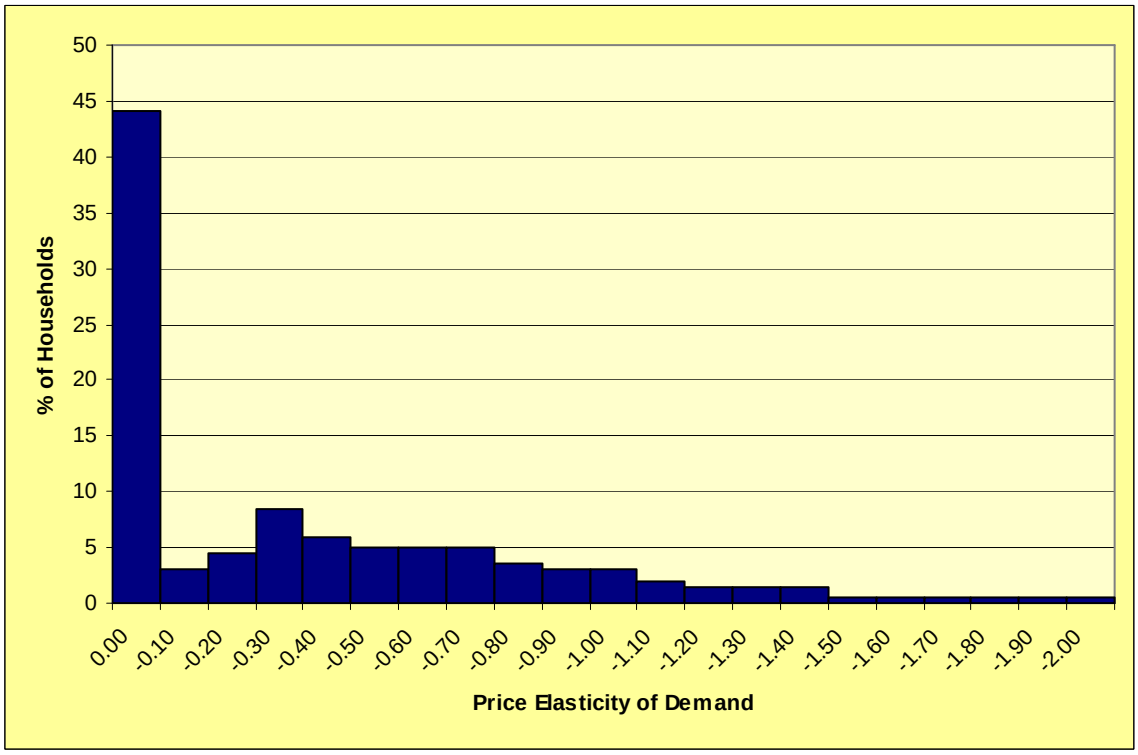
Quartile	*Range*	*Estimate of Price Elasticity*
1st	Less than $18,000 per yr	-0.49
2nd	$18,000 to $37,000	-0.34
3rd	$37,000 to $60,000	-0.37
4th	More than $60,000	-0.29

Source: Reiss and White (2001)

The findings confirm intuition that consumers with lower income levels are more responsive to price increases.

Reiss and White suggest that there are effectively two 'types' of households with respect to electricity demand behavior: those who use exhibit some electricity price elasticity, and those who do not and are evidently price insensitive. They developed the chart below to show the distribution of price elasticities for the California population.

FIGURE 3: Estimated Distribution of Households' Electricity Price Elasticities



Source: Reiss and White (2001)

Figure 3 brings into focus the substantial heterogeneity in households' price sensitivities. The striking feature of this distribution is its asymmetric, negatively skewed form. This pattern indicates that about half of all households will make very little change in their electricity consumption in response to a price change. The other half respond actively to price changes, with many consumers – those on the far right – making aggressive changes when prices go up.

This heterogeneity is consistent with findings of recent focus groups in California associated with the Statewide Pricing Pilot, where residential customers fell into three categories, depending on their receptivity to dynamic pricing: concerned, indifferent, and enthused.[10] Presumably, in a voluntary program, few of the first group would participate – including reducing peak demand – some of the second, and most of the third.

Conclusion

[10] - Hiner, H., "Market Response to Time-Varied Pricing," Presentation at AESP/EPRI Pricing Conference, Chicago, Illinois, May 14, 2003.

As detailed above, both the California Statewide Pricing Pilot and the extensive literature on the subject indicate that consumers provide significant responses to electricity price signals. That response tends to be relatively consistent across different geographies and rate types. Also, there is significant diversity in response; some customers are very responsive, others not at all. The California pilot and literature suggest Ontario's plans for time-based pricing for residential customers are well founded and will result in significant demand response.

If you have any questions on the attached or otherwise, I would be pleased to provide additional information and may be reached at 510-558-9107 x111 or chris.king@utility.com.

Sincerely yours,

Chris King
Chief Executive Officer

Attachment

Written Submission

Enbridge Gas Distribution to the Ontario Power Authority
in the matter of the province's energy supply mix
August 26, 2005

Introduction: Enbridge Gas Distribution ("Enbridge") is pleased to provide this response to the Call for Written Submissions issued by the Ontario Power Authority in the matter of the province's energy supply mix. The following considerations reflect Enbridge's 157-year history of anticipating and adapting to changing energy circumstances in Ontario, and meeting the changing needs of generations of customers.

Natural gas - Part of a diverse energy portfolio: Ontario's natural gas sector is well-positioned to play its part in realizing the government's stated goal of a diverse supply of competitively priced power within a conservation culture:

- ***Sufficient supply:*** There will be enough natural gas supply to meet future needs. Natural Resources Canada has calculated total remaining natural gas reserves in North America alone at 75 times current consumption levels. In addition, significant additional reserves have been and are being identified.

- ***Fair and reasonable prices:*** Natural gas is and will remain an economic energy choice. Based on the experience of Enbridge's own customers in recent years, natural gas has been on average about 39% less expensive than electricity and 20% less expensive than oil.

- ***Environmental benefits:*** Environment Canada has noted that natural gas-fired power generation emits the lowest level of greenhouse gases among all fossil fuels. In addition, an independent study released by the Ministry of Energy in April 2005 concluded that a combination of nuclear and natural gas-generated electricity was the lowest-cost energy scenario in terms of money, public health and the environment.

- ***Conservation culture:*** The natural gas sector has initiated a number of energy efficiency programs to help customers reduce the amount of natural gas they use. Programs implemented by Enbridge between 1995 and 2004 alone reduced consumption by the equivalent of the gas used by 620,000 homes in one year. Those same programs reduced carbon dioxide emissions by the equivalent of removing 750,000 cars from the road for one year.

- ***Advancing stated public policy objectives:*** As noted above, natural gas can advance the Ministry's stated desire for diversity of supply. It also advances the findings of an Ontario Energy Board ("OEB") report issued in March 2005, which recognized the important and growing role of natural gas and natural gas infrastructure in the province's energy system.

Fuel switching - The focus of this submission: There are a number of ways in which natural gas can contribute to the achievement of the province's stated energy needs and objectives. One way is through large scale electricity generation. Another is through distributed energy. Still another is through energy efficiency models that provide demand side management and other programs tailored to particular classes of customers.

The focus of this submission, however, is on another aspect of the natural gas component of a diverse energy mix. This aspect - fuel switching – entails the switching of customers from electric appliances to natural gas appliances that can perform the same chores, often in a more effective and cost-efficient way.

Fuel switching - The plan and the benefits: The remainder of this submission discusses a five-year plan for the switching of 1,043,425 furnaces, water heaters, ranges and dryers from electricity to natural gas. Under this initiative, the benefits to Ontario would include:

- ***Reduced electricity demand:*** Peak load electricity demand would be reduced by 1,490 megawatts.

- ***Avoided generation costs:*** The move to natural gas-fired appliances would realize avoided electricity generation costs of $1.146 billion.

- ***Decreased greenhouse gas emissions:*** The switch from electric to natural gas appliances would lower greenhouse gas emissions by 2.5 million tonnes.

Fuel switching - The potential for quick 'wins': One of the key attributes of the fuel switching initiative is the speed with which the benefits could be realized. This is due, in part, to the fact that the natural gas infrastructure and technology to implement such a program are already in place. There follow three areas or quick 'wins' that demonstrate the benefits that can be achieved for Ontario in short order, using existing technology, and building on current or reinforced infrastructure.

- ***Space heating:*** Electrical residential space heating can account for up to 60% of residential electricity use. Switching the space heating source from electricity to natural gas furnaces could save $1.1 billion in avoided generation costs.

- ***Water heating:*** Heating water electrically can total up to 20% of residential electricity use. Switching to natural gas tankless water heaters can increase energy efficiency and lower customer costs

- ***Helping low income residents:*** Approximately 14% of Ontario residents live at or near the poverty line. More than 50% of them use electric water heaters, which cost more to operate than natural gas heaters. Thus, people who can least afford it are paying more to heat their water than they have to. Switching their water heaters from electricity to natural gas has the potential to save this group some $146 million in avoided generation costs.

Fuel switching - The role of incentives: One way to encourage the implementation of any fuel switching initiative is to make the prospect attractive to customers. Here, as elsewhere in the economy, retail prices can influence consumer choices and buying decisions. The cost of purchasing new natural gas appliances, before the end of the useful life of existing electricity appliance stock, can be an impediment to change with many customers. This fact alone can deter consumers from pursuing the natural gas option, even though they can realize significant cost savings over the life of those natural gas appliances.

One way to encourage consumers to choose the natural gas option, and to realize the potential benefits for the province, is through the use of direct-to-ratepayer incentives for purchasing natural gas appliances. Such incentives could be provided in one of two ways. The first is by the provincial government itself. The second is through the regulatory process in which local utilities would factor such incentives into their rate structure, build cost recovery plans into their rate submissions, and seek approval of those submissions through the OEB in the normal course.

Either way, if direct-to-ratepayer incentives were provided for 50% of the purchase price of switching to natural gas appliances, and as the Fuel Switching – Summary Results document appended to this submission indicate, Ontario would still realize net avoided generation costs of $617 million under the proposed five-year fuel switching program.

Fuel switching - Other considerations: Enbridge recognizes that other considerations are associated with the proposed fuel switching initiative. One is that the cost of the related system expansion would fall within natural gas utility rates. Another is that the demand for natural gas would increase. Analysis suggests, however, that the increased use would equal just 0.2% of total North American demand. A third factor is the proposed five-year timetable itself. Enbridge believes that this schedule, while aggressive, is achievable using current technology and building on current infrastructure.

In conclusion – Natural gas, fuel switching, and the benefits to Ontario: By way of summary, and in support of its proposed five-year fuel switching initiative from electric to natural gas appliances, Enbridge Gas Distribution submits that:

- **Natural gas can do its part:** Natural gas is well-equipped to play a significant role within Ontario's changing energy mix. It is plentiful, economical, and environmentally sound.

- **Fuel switching is a viable and achievable initiative:** Fuel switching from electric to natural gas appliances - an initiative that is being pursued elsewhere - can be achieved at low risk through existing infrastructure and technology.

- **Ontario will benefit:** The fuel switching initiative will, among other things, address the government's stated policy objectives, reduce electricity demand, avoid generation costs and lower greenhouse gas emissions.

APPENDIX

Fuel Switching– Summary Results

	Over 5 years
Megawatts Saved (Diversified Demand)	**1,490**
Net GHG Emissions Reduced	**2.5 million tonnes**
Cost of 1,490 MW NG Fired Generation	**$1.146 billion**
Incentive Cost (@ 50% of replacement)	**$0.529 billion**
Avoided Generation Cost	**$0.617 billion**
Ratio of NG Fired Generation Costs to Incentive	**2 to 1**
Total Electric Appliances switched	**1,043,425**
Furnaces	**114,875**
Water Heaters	**279,200**
Ranges	**323,000**
Dryers	**326,350**

Market Transformation Assumptions

Enbridge Gas Distribution Inc.			**Market Penetration**				
		5 Years		**Existing Home**		**New Homes**	
Residential Customers	1,525,000		**Appliance**	**Current**	**Proposed**	**Current**	**Proposed**
New Home additions	40,000	200,000	**Furnaces**	90%	93%	98%	100%
System Expansion/year	4,500	22,500	**Water Heaters**	86%	93%	91%	96%
Infill Customers/year	5,000	25,000	**Ranges**	24%	34%	24%	34%
			Dryers	30%	46%	30%	40%
System Expansion	35% electricity / 65% oil						
Infill Customers	35% electricity / 65% oil						
Heating only	35% electricity / 65% oil						

Union Gas			**Market Penetration**				
		5 Years		**Existing Home**		**New Homes**	
Residential Customers	1,200,000		**Appliance**	**Current**	**Proposed**	**Current**	**Proposed**
New Home additions	20,000	100,000	**Furnaces**	92%	95%	100%	100%
System Expansion/year	1,000	5,000	**Water Heaters**	85%	92%	86%	96%
Infill Customers/year	4,000	20,000	**Ranges**	19%	29%	19%	29%
			Dryers	21%	31%	21%	31%
System Expansion	50% electricity / 50% oil						
Infill Customers	50% electricity / 50% oil						
Heating only	50% electricity / 50% oil						

A RESPONSE TO OPA'S CALL FOR WRITTEN SUBMISSIONS

ELECTRICITY CONSERVATION:

IT'S NOT JUST A HARDWARE SOLUTION

A WRITTEN SUBMISSION
ON

WEBGEN SYSTEM'S
INTELLIGENT USE OF ENERGY (IUE®) SYSTEM
AS
AN EXAMPLE OF THE BEST-OF-BREED WIRELESS, INTERNET-BASED ADVANCED SOFTWARE ENERGY CONSERVATION TECHNOLOGIES

PREPARED BY:
DAVID G. TOOLE
VICE CHAIR – BUSINESS DEVELOPMENT
COMPLETE CONTROL CORPORATION /
ENCOMPASS TECHNOLOGIES INC.
AUGUST 26, 2005

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EXECUTIVE SUMMARY

This paper responds to the second OPA issue area – "Appropriate approaches to constructing CDM (Conservation and Demand Management) portfolios for inclusion in long-term plans". It is structured to deal with, as much as possible, established data on technical and achievable potential, costs, implementation barriers, sector specific characteristics, and experience in implementation of CDM, and technology developments.

The opinions expressed in this paper are solely those of the author and in no way should be viewed as commitments by either Complete Control Corporation/Encompass Technologies Inc. or WebGen Systems Inc.

The thrust of this paper is to suggest that a wireless, internet and advanced software technological paradigm shift has occurred that can dramatically improve Ontario's programmatic electricity conservation efforts in contrast to more expensive "hardware" oriented solutions. These wireless, internet and advanced software technologies are now ready to occupy a legitimate place in the proactive electricity conservation space. WebGen System's Intelligent Use of Energy (IUE®) is used as an example of the "best-of-breed") of these types of technologies. It must be emphasized that these technologies have focussed on the commercial sector since their introduction during the past decade. Any calculations regarding the industrial and residential sectors in this paper are speculative but based on relatively expert opinion. Real and significant technological developments are required for these technologies to penetrate these industrial and residential sectors.

The paper assumes, amongst other assumptions, that the Ontario Government mounts a serious promotional and financially attractive program for the introduction of these technologies into first the commercial sector followed by the industrial and residential sectors. Of course, the impact of these programs is speculative, but given a proactive program, the penetration levels of these technologies into these sectors, assumed in this paper, are possible.

If the assumptions and calculations contained in this paper are accepted, then in-ground electricity generation supply capacity could be replaced through electricity conservation using these technologies for between a scant $45,000 per MW and $1.5 million per MW depending on whether the application is in the commercial, industrial or residential sectors. Total MW conservation reductions could range from 80 to 130 MW in 2007, 170 to 280 MW in 2010, 280 to 450 MW in 2015, 400 to 660 MW in 2020 and 645 to 1,040 MW in 2025.

To accomplish these remarkable results, the paper recommends the following courses of action –

1. That the OPA Conservation Bureau commission a full and comprehensive study on these technologies to verify or modify the contentions put forward in this paper;
2. That the OPA Conservation Bureau follow closely the WebGen -
    a. York Region Demand Reduction program recently sponsored by the OPA where it is expected, by the author, that these technologies, through WebGen, will play an important role;
    b. Cadillac Fairview TD Tower (Ernst & Young Tower) pilot.
3. That the OPA Conservation Bureau seriously considers the inclusion of these technologies in its long-term Supply Mix plans for electricity conservation, depending on the results of the aforementioned study.

More information about the Complete Control Corporation and WebGen Systems can be found at www.completecontrol.ca and www.webgensystems.com

I INTRODUCTION & BACKGROUND

The thrust of this paper is to promote wireless, internet and advanced software technological paradigm shift as a method that can dramatically improve Ontario's programmatic electricity conservation efforts These current electricity conservation efforts have focussed primarily on solutions such as "hardware" (Smart Meters and Building Management Systems) and programs or public appeals for reduced electricity consumption.

As suggested, the electricity supply debate has centered on in-ground construction of generation, transmission or distribution plant. It has been the purvey of system planning engineers and their design and construction engineering colleagues. On the conservation side this same engineering of "hardware" oriented Smart Meters and building automation systems appear to have dominated the discussion as longer-term solutions for the reduction of demand through conservation with short-term appeals and programs to hopefully entice electricity consumers to reduce consumption.

But the technological landscape has changed dramatically over the past decade or so: consider the impact that wireless, internet and advanced software technologies have had on how we conduct our personal and business lives.

These same wireless, internet and advanced software technologies are now ready to occupy a legitimate place in the proactive electricity conservation space. Indeed, it is the contention of this paper that the use of these technologies must become part of the public consciousness through an open public understanding of the power of these technologies to "invisibly" and programmatically assist electricity consumers to reduce their consumption and costs while having a positive impact on the gap between electricity supply and demand.

It appears that other jurisdictions are leading Ontario in the exploration of the use of these wireless, internet and advanced software technologies to dramatically reduce electricity consumption. This paper hopes to imbue the reader with a "brave new Ontario vision" of an electricity demand conservation environment that involves electricity consumer *pre-programmed* choices in how they reduce their demand, in their best selfish best interests, *automatically* in a manner that is tied to electricity market prices and regional or aggregate Ontario demand.

Imagine an Ontario electricity consumption environment in which –

- customers can choose their electricity price tolerances and decide, in a price sensitive manner, to *variably* reduce their electricity consumption *according to price* along the momentary electricity price curve
- customers can have these electricity consumption-to-price choices happen automatically without any action on their part other than making the initial, and modifiable, decision about how they want to react to a variable number of points on the electricity price curve and the extent to which they were prepared to voluntarily have this occur automatically on their behalf
- the IESO will know, with relative certainty, programmed electricity conservation choices allowing it to adjust its generation supply requirements in a predicable way during regional and aggregate Ontario high electricity demand periods

This scenario is not "pie in the sky" thinking but an electricity conservation situation that is currently available with proven wireless, internet and advanced software technologies. The creation of this conservation environment simply requires Ontario Government vision and commitment to a strategically programmatic approach to its achievement.

As one of the few wireless, internet, advanced software system providers, this paper will feature WebGen Systems proprietary technology, the Intelligent Use of Energy (IUE™) system since WebGen has CDM experience and -

- current successes in the institutional and commercial properties sector. The paper will go on to describe how this could be expanded into other sectors including residential over the period 2007 to 2025.
- over 100 million of current USA square feet of property under electricity management using the IUE™ system
- a successful Demand response test with the California energy regulator and other electricity market jurisdictions.

This paper will also discuss the very real and practical potential to expand the scope of WebGen-like technologies beyond the institutional and commercial electricity consumption sector into a full partnership with the Ontario Government in the industrial and potentially residential conservation arena over the next 20 years.

But, most provocatively, is the capability of WebGen like technologies to satisfy part of the Ontario Government's requirement for a 5% reduction in electricity demand by 2007

WebGen's IUE™ System builds a connection to a Building Management System (BMS) over the Internet, and using Artificial Intelligence, it learns how the building operates, is connected to weather data, the IESO and subsequently introduces a more comprehensive, proactive, ongoing and variable level of control according to stepped price sensitive parameters provided by the building occupant. Ongoing electricity conservation levels have been greater than 5% over savings already experienced through the existing BMS.

II HOW WIRELESS, INTERNET-BASED, ADVANCED SOFTWARE CDM SOLUTIONS CAN BE MADE AN INTEGRAL PART OF ONTARIO'S ENERGY CONSERVATION SUCCESS

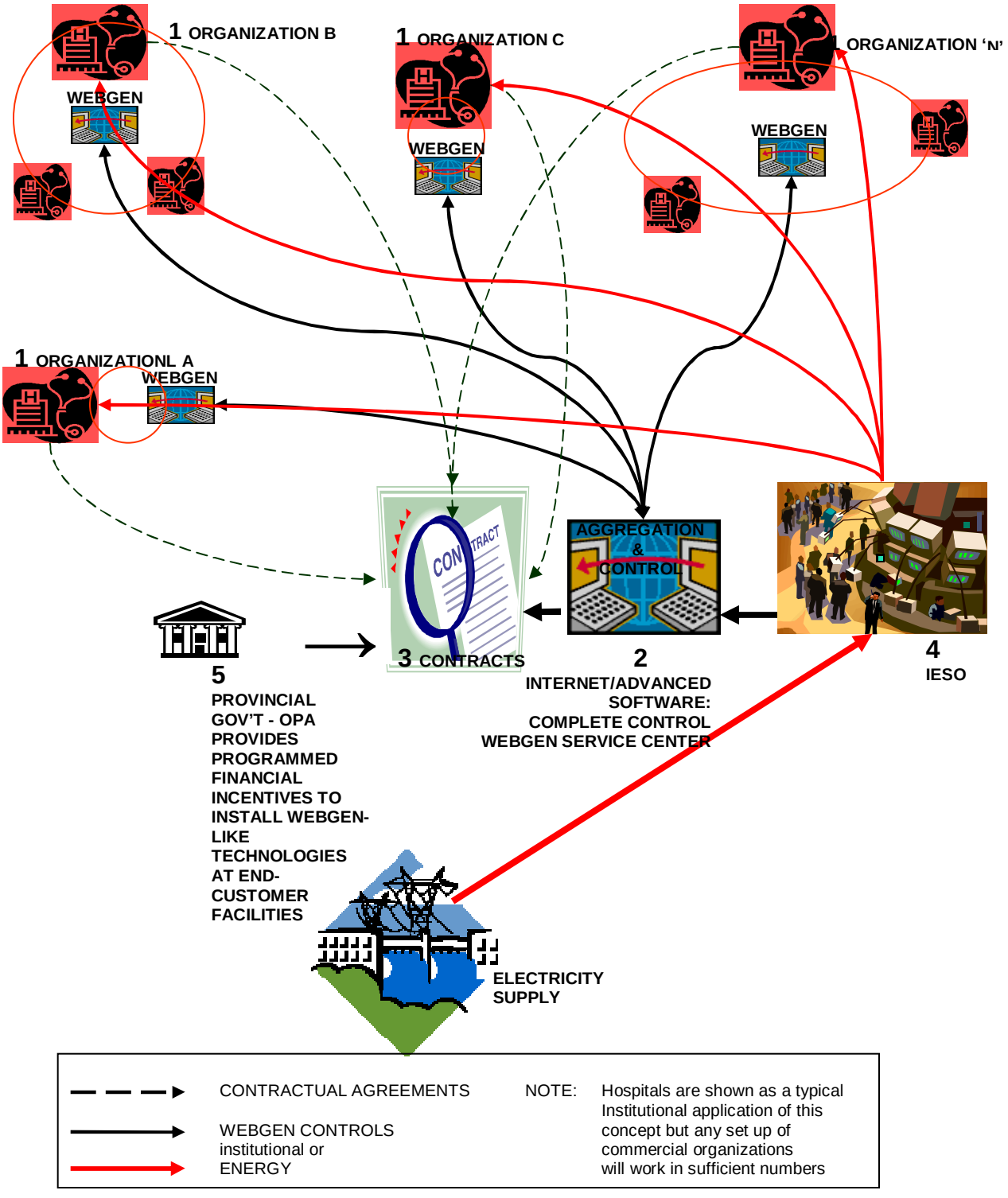
APPLICATIONS BY 2007

There are five key elements need to be in place to immediately reap a dramatic, programmed and predictable conservation of electricity in Ontario –

1. **Organizations** who are prepared to install an Internet-based advanced software system such as WebGen. It would be ideal but not mandatory that these organizations already have a BMS installed. The impact of a programmed approach will be to
    a. rapidly expand penetration into the first institutional and commercial sector through an integrated OPA sponsored program
    b. provide the IEMO will verifiable information about automatic demand reductions at various price points on the daily market cost-of-power curve
2. **Wireless, Internet based advanced software technologies** that can automatically manage customer responses to increases in the cost of power. These technologies should be able to work in easy conjunction with Smart metering technologies. These service providers should be prepared to establish Ontario based Control Operations when the financial opportunity warrants. By any standard, WebGen is amongst the "best-of-breed" in this technological space.
3. **Contractual arrangements** through which the
    a. initial installation is subsidized, to some degree by OPA, in return for integration with the IEMO
    b. terms of each customers response to increases in the cost-of-power would be stipulated
    c. ongoing energy cost savings are shared between the customer and the advanced technologies service provider
4. **The IESO** who would receive verified advance knowledge of the regional and province-wide electricity conservation levels based on the program
5. **The government, presumably through its OPA agent**, who would promote and subsidize the installation of internet-based advanced software CDM solutions.

Figure 1 below shows the relationship of these five key elements. After this figure is more detail on how this program can be rolled out and expanded during the 2010 to 2025 period.

Figure 1 **The Five Key Elements Needed To Dramatically Conserve Electricity In A Customer Friendly & Predictable Program Using Internet & Advanced Software Technologies**


1 ORGANIZATION B
WEBGEN
1 ORGANIZATION C
WEBGEN
ORGANIZATION 'N'
WEBGEN
1 ORGANIZATIONL A
WEBGEN
AGGREGATION & CONTROL
3 CONTRACTS
2
INTERNET/ADVANCED SOFTWARE: COMPLETE CONTROL WEBGEN SERVICE CENTER
4
IESO
5
PROVINCIAL GOV'T - OPA PROVIDES PROGRAMMED FINANCIAL INCENTIVES TO INSTALL WEBGEN-LIKE TECHNOLOGIES AT END-CUSTOMER FACILITIES
ELECTRICITY SUPPLY
CONTRACTUAL AGREEMENTS
WEBGEN CONTROLS institutional or ENERGY
NOTE: Hospitals are shown as a typical Institutional application of this concept but any set up of commercial organizations will work in sufficient numbers

THE WEBGEN ADVANTAGE: AUTOMATIC VERSUS MANUAL CONSERVATION RESPONSES

Although WebGen has effective Demand Response capabilities, a vital impact that WebGen can have is to reduce and shift electricity demand in an ongoing way during all periods of the day in a manner that is responsive to the daily electricity market price curve. It does not require the electricity consumer to manually change consumption but rather WebGen will do this on their behalf according to voluntary pre-determined and agreed to conservation-to-price decisions.

Present methods to industrial, commercial, institutional and residential encourage ongoing electricity conservation include –

- promoting lighting upgrades and energy efficient appliances
- promoting time shifting of use (residential appliances through to commercial and institutional space air conditioning & heating)
- promoting energy efficient buildings
- OPA's Conservation Challenge to promote reductions in electricity use through the better use of electricity in organizations

Currently, the IESO has four programs to conserve electricity during periods of peak demand. Three of these are programmatic and predictable to varying degrees –

- Dispatchable Load – According to the IESO's 18 month outlook, there is currently about 352 MW that are counted upon. There are almost 600 registered by large volume customers that are Market participants in the IESO administered market. It is expected that there will be 700 MW that can be counted upon within 18 months.
- Energy Demand Response – These are contractual arrangements between the IESO and large customers who are willing to have their power consumption curtailed for a fee that is only paid when the load is asked to be shut off by the IESO for an emergency, as the last step in emergency procedures before rotating blackouts - 417.8 MW with 11 market participants (load) until April 20, 2005 and reducing since then to 327.8 MW with 9 market participants (load).
- Transitional Demand Response – Activated in October 2004, this program has been rolled out in two rounds for a total of 75 MW. The program aims to "kick start" demand response in Ontario by compensating participants for reducing demand based on pre-dispatch price signals.
- Also, the IESO has determined that about 200 to 300 MWs of industrial and commercial demand are price sensitive and usually react to lower electricity consumption during high price periods

The first two of these programs are more automatically effective since they happen according to pre-set arrangements with the IESO. The Transition Demand Response program still requires a manual response as in the Milton Energy Drill program.

However, none of these efforts provide a programmed and predictable ongoing load conservation outcome. According to the IESO the impacts of appeals for electricity conservation during peak periods are difficult to assess. Any variable electricity conservation effort that produced predictable reductions of greater than 50 MWs of demand reduction would be of significance to the IESO.

It is the contention of this paper that the simple knowledge of time-of -se costs will not automatically cause electricity consumers to reduce use since this still requires an active response by the consumer. Pre-programmed residential home thermostats are a great first step but only reflect the real regional and provincial demand curve through the approximation of time settings. WebGen can tie to either market prices – a closely related proxy measure for electricity demand – or actual demand itself.

APPLICATIONS 2010 TO 2025

As Ontario moves forward into 2007 and beyond, the two dichotomies of individual freedom to consume electricity and the realities of electricity supply with the associated need for government control, may collide in a manner that is both socially and politically unpalatable to the Ontario Government and OPA.

It is hoped that the time-of-use information provided by Smart Meters will cause consumers to adjust and time-shift their electricity buying preferences. Also, over the period 2007 to 2025, it is expected that the true cost of the provision of electricity will be borne by consumers through eventually paying the full market price of power after sufficient independent generation is brought on-stream to create a truly competitive electricity supply marketplace. Indeed, within this context, OPA itself is a transition device that is meant to smooth the movement from controlled electricity prices to full market pricing for the vast majority of individual Ontarians.

So, from one perspective, one of the "crunch" issues is determining the year that full market pricing will occur for all Ontario electricity consumers– residential, industrial, commercial and institutional (education & health) so that regular electricity consumer voluntary conservation will coincide with supply realities and remove the possibility of the "collision of these two dichotomies". However wireless, internet-based advanced software technologies have the potential to remove this possible "collision" of interests as part of not only to full market pricing but also following this, to aid electricity consumers in their price sensitive responses to the price of power.

The problem is, and will continue to be, what to do about electricity conservation and how to easily do it. For example, supposing sometime in the period 2007 to 2012, small business, residential or institutional electricity consumers know what they are paying and when for electricity through Smart Meters. Just what are they expected to do to fine tune their conservation efforts to the instant electricity supply price? Run around to voluntarily and manually adjust thermostats and turn off equipment? A more automatic and equally voluntarily method could be available through the use of wireless, internet-based advanced software technologies such as WebGen.

What must happen to have the institutional and commercial capabilities available to these small businesses, residential and institutional electricity consumers? Just four changes –

1. The cost of installing the technologies must reduce and this installation must be coordinated with the Local Electricity Distribution Company (LEDC). But, already these technologies are available at a cost that is attractive when compared to either new traditional or renewable generation or Smart Meters;
2. The Ontario Government, through OPA must actively and programmatically endorse the strategically expanded use of these technologies;
3. Proof of the viability of these technologies to produce meaningful and ongoing demand reductions must be developed through pilot tests in sectors other than institutional and commercial and finally
4. A start must be made now to programmatically introduce these technologies in the two sectors where they have already been proven effective – the commercial and institutional sectors.

Should these steps happen, then the dramatic reductions for 2010, 2015, 2020 and 2025, shown later in this paper could readily become reality.

III SECTOR SPECIFIC CHARACTERISTICS

Currently most WebGen-like technologies have focussed on the commercial property, educational and health/hospital facility markets. Significant technological hurdles must be overcome for these types of technologies to economically service the industrial and residential sectors. However, this technological development could occur relatively quickly, given the right types of partnerships with the Ontario Government.

IV TECHNICAL AND ACHIEVABLE POTENTIAL

WEBGEN TECHNICAL BRIEF

The IUE® System works in conjunction with the building management system to put all matters linked with energy consumption under a single umbrella. Each of the six IUE modules that constitute the IUE Suite is dedicated to addressing a particular set of energy-related concerns. The six modules are IUE Trend™, IUE Finance™, IUE Agent™, IUE Demand Response™, IUE D-Gen™,and IUE Critical Response™.

The IUE System operates via a single gateway to the building management system (BMS) and/or meter. This non-intrusive and secure connection (i.e., firewall) allows any combination of the IUE Suite modules to be easily integrated for transport of the building's installed system protocol because the data is ultimately transferred as standard packets of BACnet® or XML. The organization can take advantage of the real-time system via a single-direction (read only) connection to IUE Trend and IUE Finance, while greater functionality can be obtained through the read/write capabilities of IUE Agent, particularly as modules are added to address specific energy management goals.

IUE System Control begins with the default parameters set by the BMS. From there, a series of "triggers" activate the various IUE modules as a means to uncover the energy savings opportunities that exist as a result of the inherent discord between the actual energy-related conditions (e.g., current weather, energy prices, building occupancy, etc.) and the fixed settings of the BMS. Specifically, IUE Demand Response (IUE DR) provides Emergency Curtailment actions as defined by the organization's special energy contracts with the utility or ISO, while IUE Agent implements Permanent Load Reduction (PLR) and Peak Load Avoidance (PLA) to optimize energy usage. The system provides these measures using neural network-based precision forecasting tools and one (or more) of the many industry-standard methods available to optimize energy consumption.

IUE® is a registered trademark of WebGen Systems, Inc. BACnet® and LonWorks® are registered trademarks of their respective owners.

ASSUMPTIONS

ASSUMPTIONS - DEMAND SEGMENTS

The following assumptions have been made –

1. That aggregate electricity supply requirements at time of high peak demand in 2007 is 25,500 MW
2. That the aggregate, approximate segmentation in supply requirement in 2007 is
    a. One third – industrial or 8,500 MW
    b. One third – commercial/institutional or 8,500 MW and
    c. One third – residential or 8,500 MW
3. That the Commercial/Institutional supply requirement at high peak in 2007 is segmented as follows –

a. Commercial properties – 60% or 5,100 MW
b. Educational – 20% or 1,700 MW (it is recognized that this likely varies in the summer months)
c. Health/hospitals – 20% or 1,700 MW

And that this relationship stands for the period to 2025

4. That the annual growth in demand and hence overall electricity supply requirement growth will be about 1%
5. That Commercial/Institutional annual demand per gross square foot is –
    a. Commercial – 22kWh
    b. Educational – 13 kWh
    c. Health/hospitals – 35 kWh
    d. That it requires the following MWs installed generation capacity to service –
        i. a 300,000 ft^2 commercial building = 0.74 MW
        ii. the applicable portions of a 300,000 ft^2 industrial building – 0.66MW
        iii. 1000 residential homes = 1.3MW

6. That full market pricing for all Ontario electricity consumers will occur about 2015

ASSUMPTIONS – PENETRATION OF TECHNOLOGY

1. That the introduction of wireless, internet-based advanced software technologies along with increased electricity costs will lead the use of these technologies according to the following percentages of segmented electricity supply requirements

SECTOR	YEAR				
	2007	**2010**	**2015**	**2020**	**2025**
COMMERCIAL	20%	30%	35%	40%	45%
INDUSTRIAL	0	6%	10%	20%	30%
RESIDENTIAL	0	6%	20%	30%	40%

2 That wireless, internet-based advanced software technologies will lead to the following conservation of the use of electricity and, hence to a corresponding reduction in high peak electricity supply requirements
    a. Commercial/Institutional
        i. Commercial – 5 to 8%
        ii. Educational – 5 to 8%
        iii. Health/hospitals – 4 to 6%
    b. Industrial – 4 to 7%
    c. Residential 5 to 8%

3. That the Ontario Government mounts a significant financial incentive and promotional program during the period 2005 to 2007 – say a 25% to 50% subsidy of the installation cost.

ASSUMPTIONS – COSTS

1. That the one-time cost to install WebGen-like technologies in a 300,000 square foot commercial facility is $50,000

2. That the cost to install WebGen-like technologies in a 300,000 square foot industrial/manufacturing/distribution center facility is $80,000

3. That the cost to install WebGen-like technologies in a residential home will be $2,000 if a subdivision can be treated as a total facility with individual homes treated as "zones" with "sub-zones".

4. That residential applications will be installed by the LEDC

5. That the ongoing cost of WebGen-like technological services will be paid from ongoing electricity financial savings in an agreement between the electricity consumer and service providers such as WebGen Systems

6. That it will be strategically and financially viable for service providers such as WebGen to develop the technologies to satisfy the industrial and residential beyond their traditional commercial and institutional service base

PREDICTIONS – POTENTIAL PREDICTABLE REPLACEMENT OF ELECTRICITY SUPPLY THROUGH THE CONSERVATION OF ELECTRICITY BY USING THESE TECHNOLOGIES

It should be recognized that these are illustrative estimates to show the conservation potential of these technologies.

YEAR	SUB-SECTOR	SUB-SECTOR ELECTRICITY SUPPLY REQUIREMENT IN MWS	SUB-SECTOR TECHNOLOGY PENETRATION IN MWS	SUB-SECTOR ELECTRICITY CONSERVATION IN MWS	TOTAL COMMERCIAL SECTOR POTENTIAL CONSERVATION SAVINGS RANGE IN MWS
2007	COMMERCIAL	8,500	1700	80-128	≈ 80-130
	INDUSTRIAL	8,500	0	0	
	RESIDENTIAL	8,500	0	0	
2010	COMMERCIAL	8,750	2600	125- 204	≈170- 280
	INDUSTRIAL	8,750	520	20- 36	
	RESIDENTIAL	8,750	520	26- 40	
2015	COMMERCIAL	9,200	3220	154- 245	≈ 280- 450
	INDUSTRIAL	9,200	920	36- 64	
	RESIDENTIAL	9,200	1840	92- 147	
2020	COMMERCIAL	9,650	3860	185 - 294	≈ 400- 660
	INDUSTRIAL	9,650	1930	77 – 135	
	RESIDENTIAL	9,650	2895	145 – 232	
2025	COMMERCIAL	10,150	4568	320-500	≈ 645-1040
	INDUSTRIAL	10,150	3045	122-213	
	RESIDENTIAL	10,150	4060	203-325	

These potential conservation impacts were developed using the assumption that a significant Ontario Government program encouraged commercial, industrial and residential electricity users to install these technologies.

V COSTS

Costs have been developed by calculating the annual demand of typical commercial, industrial (the commercial elements only – office space etc) and residential, determining the number of installations required to satisfy the above MW conservation savings and then costing these installations using the installation cost assumptions noted earlier in this paper.

Significantly, if these calculations and assumptions are correct, then these technologies provide a significantly inexpensive method to replace the construction of additional electricity generation – the last column (right) in each table below.

The costs to install WebGen-like technologies vary by sector and by facility size and complexity –

YEAR	SECTOR COMMERCIAL	PREDICTION: MW SAVED OR REPLACED	NUMBER OF FACILITIES TO ACHIEVE MW CONSERVATION PREDICTIONS STANDARD SIZE: 300,000 FT^2	TOTAL COST ($MILLIONS)	COST PER MW OF ELECTRICITY SUPPLY REPLACED BY WEBGEN-LIKE TECHNOLOGIES' CONSERVATION ($000'S)
2007	Commercial	80 – 128	108 -173	5.4 – 8.7	67.5 – 70.0
2010	Commercial	125- 204	168 – 275	8.4 -13.8	67.2 – 67.6
2015	Commercial	154- 245	208 – 330	10.4 – 12.3	67.5 – 50.0
2020	Commercial	185 - 294	250 – 397	12.5 – 20.0	67.6 – 68.0
2025	Commercial	320-500	432 – 675	21.6 – 33.8	67.5 – 67.6

YEAR	SECTOR INDUSTRIAL	PREDICTION: MW SAVED OR REPLACED	NUMBER OF FACILITIES TO ACHIEVE MW CONSERVATION PREDICTIONS (FACILITIES ≥ 300,000)	TOTAL COST ($ MILLIONS)	COST PER MW OF ELECTRICITY SUPPLY REPLACED BY WEBGEN-LIKE TECHNOLOGIES' CONSERVATION (000'S)
2007	Industrial	0	0	0	0
2010	Industrial	20 – 36	30 – 54	2.4 – 4.4	120 0 – 122.0
2015	Industrial	36 - 64	54 – 96	4.4 – 7.7	122.0 – 120.0
2020	Industrial	77 – 135	116 – 203	9.3 – 16.2	121.0 – 120.0
2025	Industrial	122 – 213	183 – 320	14.6 – 25.6	120.0 – 120.2

YEAR	SECTOR RESIDENTIAL	PREDICTION: MW SAVED OR REPLACED	NUMBER OF HOMES TO ACHIEVE MW CONSERVATION PREDICTIONS	TOTAL COST ($MILLIONS)	COST PER MW OF ELECTRICITY SUPPLY REPLACED BY WEBGEN-LIKE TECHNOLOGIES' CONSERVATION ($MILLIONS)
2007	Residential	0	0	0	0
2010	Residential	26 – 40	19,000 – 29,200	38.0 – 58.4	1.5 – 1.5
2015	Residential	92 – 147	67,200 – 107,300	134.4 – 215.0	1.5 – 1.5
2020	Residential	145 – 232	105,900 – 169,400	211.8 – 339.0	1.5 – 1.5
2025	Residential	202 – 325	147,500 – 237,300	295.0 – 475 0	1.5 – 1.5

VI IMPLEMENTATION BARRIERS

Implementation barriers vary by sector –

Commercial

- Landlord concerns about tenant comfort and energy supply quality
- Lease structures and pass-through clauses on energy costs
- A reluctance to try new technologies
- Capped prices In the educational and health/hospital sub-sectors of the commercial sector

Industrial

- Technology development
- Concerns about productive capacity and profitability
- A lack of knowledge about the capability of these technologies to create "zones" with an industrial complex and instantly and proactively manage these zones differently according to different price points on the momentary market price of electricity
- A reluctance to try new technologies

Residential

- Technology development
- No current specific knowledge of time-of-use costs
- Coordination with LEDCs
- No real program that allows for automatic instant responses to price increases
- Capped prices
- Lifestyle choices and a belief that the use of electricity is a "right"

VII EXPERIENCE IN IMPLEMENTATION OF CDM

In the USA, WebGen's CDM implementation experience is extensive with more than 100 million square feet of property under its energy administration in the financial, commercial properties, educational and health sectors. A sampling of WebGen's clients can be found at www.webgensystems.com. WebGen is just entering Canada, with its affiliation with Complete Control/Encompass Technologies.

VIII TECHNOLOGY DEVELOPMENTS

No technological developments are required by WebGen to penetrate the Commercial sector. Arrangements would be required to interconnect the IESO with the WebGen control center but this should pose no technological problems.

Penetration into the industrial and residential sectors requires technological development. Specifically, WebGen is currently not equipped to handle manufacturing processes in the industrial sector and new household oriented interfaces are required that could be economically deployed for penetration into the residential sector.

IX CONCLUSIONS

Wireless, internet-based, advanced software energy conservation technologies should be a serious part of Ontario's conservation efforts. It is recommended -

1. That the OPA Conservation Bureau commission a full and comprehensive study on these technologies to verify or modify the contentions put forward in this paper;
2. That the OPA Conservation Bureau follow closely the WebGen -
    a. York Region Demand Reduction program recently sponsored by the OPA where it is expected, by the author, that these technologies, through WebGen, will play an important role;
    b. Cadillac Fairview TD Tower (Ernst & Young Tower) pilot.
3. That the OPA Conservation Bureau seriously considers the inclusion of these technologies in its long-term Supply Mix plans for electricity conservation, depending on the results of the aforementioned study.

ATTACHMENT I
MORE INFORMATION ABOUT WEBGEN AS A "BEST-OF-BREED"
EXAMPLE OF WIRELESS, INTERNET-BASED ADVANCED SOFTWARE TECHNOLOGIES

Moving Energy to Your Bottom Line™

For more information contact us at:
WebGen Systems, Inc
Attention: Sales Department
41 Linskey Way
Cambridge, MA 02142
Tel. 617 349 0724
Email: sales@webgensystems.com
URL: www.webgensystems.com

About WebGen Systems, Inc.

WebGen Systems provides advanced software for energy conservation and control in commercial buildings. We combine the highest level of industry expertise with a reliable suite of open-protocol software tools called IUE®, which provides real-time command of energy use to generate savings. Our system connects all aspects of building energy management to automatically measure, monitor, and control energy consumption building by building, system by system, meter by meter, and device by device. In this way, we offer the most effective Enterprise Energy Management solution on the market today.

Enhance your energy management with IUE®

Achieving system interoperability has been a long and tiresome battle for facilities owners and managers. Fortunately, industry standards such as BACnet®, LonWorks® and XML have recently ended a major part of this problem, however true enterprise wide energy management requires more than open standards to be successful—particularly with so many legacy systems still in operation.
Today, energy-minded organizations are looking for the best ways to leverage the various open protocols through the use of standards-based software tools and systems. WebGen Systems delivers this leverage through a suite of software modules called IUE (Intelligent Use of Energy). Designed for both facilities management and building operations, these modules comprise a set of precise forecasting tools for measuring and optimizing energy consumption through the use of real-time data. As a leading Enterprise Energy Management System, IUE provides all the data collection and visualization in a comprehensive interface that is intuitively designed for every level of usability.

The IUE Suite™

Designed with a holistic approach to energy management, the IUE System places all matters linked with energy consumption under a single umbrella while each of the six IUE modules is dedicated to addressing a particular set of energy-related concerns. This maximizes efficiency across the organization; facilities managers are provided the best means to streamline BMS-related tasks while accounting personnel use the same system and data for financial reporting, billing, and auditing. The six modules are IUE Trend™, IUE Finance™, IUE Agent™, IUE Demand Response™, IUE D-Gen™, and IUE Critical Response™. Combined in a single easy-to-use software suite, they deliver the most effective means to ensure tenant comfort with minimum energy usage.

IUE Trend™

Enterprise-wide energy management begins with connectivity and data flow. IUE Trend provides this basis through a single gateway to your building management system (BMS) and/or meter. This non-intrusive and secure connection allows IUE Trend to be easily integrated for transport of any system protocol because the data is ultimately transferred as standard packets of BACnet® or XML. Though it is the most basic part of the IUE System, this underlying tool delivers many functional advantages such as monitoring, trending, alarming, graphing, and analysis.

IUE Finance™

Adding the IUE Finance module instantly turns energy data into financial data. Unlike the sort achieved through conventional data "batching", this tool delivers the most accurate information possible because data arrives in real-time from any combination of buildings and meters. Moreover, the module combines these parameters with other real-time data such as current weather forecasts and up-to-the-minute price feeds. This allows managers a greater degree of flexibility and control in auditing utility bills; verifying performance contracts; tracking performance contractors against a baseline; comparing energy costs across buildings on a normalized monthly basis; and gauging energy spent against a budget, among others.

IUE Agent™

The most environmentally sound energy source is conservation. This is the calling card of IUE Agent. Its function is to successfully and automatically apply energy management strategies to any building with or without a BMS—including those with the most "proprietary" legacy systems. In short, this tool contains the industry's best practices, such as load rotation, supply air temperature (SAT) reset, pre-cooling, and others. And since it applies these actions based on real-time data (such as the current weather conditions), IUE Agent delivers the minute-by-minute monitoring and adjustments needed to maximize tenant comfort while minimizing energy consumption.

IUE Demand Response™

Demand response programs can bring tremendous savings, but they also represent a risk to the organization. With IUE Demand Response, that risk approaches zero since curtailment actions no longer rely on periodic manual intervention but precise data optimized by the system. The ability to compare disparate BMS data from any meter, building portfolio, or campus along with real-time environmental and economic data (e.g., energy price feeds) gives this tool its power to deliver on these curtailment contracts. In addition to providing the facilities management team confidence to participate in these programs, IUE Demand Response automatically manages the demand response calls from the utility or the Independent System Operator (ISO), so each contract is fulfilled in the most accurate and time-efficient manner. At the same time, IUE Demand Response maintains the highest comfort across all buildings by devising the most optimal curtailment regimen based on the most current data.

IUE D-Gen™

IUE D-Gen was designed for organizations that have power generation equipment integrated within their portfolio. This tool works in conjunction with IUE Agent to give distributed generation facilities an internal monitoring and control system that is based on real-time data rather than the traditional fixed processes. The greatest benefit delivered by IUE D-Gen is the ability to manage consumption to such a degree that the excess energy can be sold back to the grid. With the addition of this module, the IUE System is not only an energy-savings device but also a new source of revenue for the organization.

IUE Critical Response™

During brownouts or blackouts, IUE Critical Response helps organizations manage the crisis by consolidating and monitoring vital parameters, such as fuel levels and UPS charging activities. This tool informs and empowers energy managers during times that might otherwise render the entire organization blind. Under regional or

national emergencies, IUE Critical Response provides a status picture that allows managers to make crucial operational decisions while the information and alarms provided enable them to make decisions that optimize the use of their underprovided energy resources. As a result, all critical functions maintain priority as the various areas of the building portfolio are precisely apportioned over the duration of the emergency.

Benefits

- Monitor all your energy programs under one umbrella
- Achieve energy savings of 12% or more annually
- Measure and optimize energy consumption in real-time
- Apply industry-standard energy management strategies to any installed BMS
- Leverage data from precise forecasting tools
- Maximize Peak Load Avoidance
- Ensure Permanent Load Reduction
- Realize payback in as little as12 to18 months
- Provide facilities managers a means to streamline BMS-related tasks
- Compare dissimilar BMS and meter data across building portfolios or campuses
- Validate utility bills
- Normalize bills to calendar months and compare across buildings
- Reduce overtime and travel costs with remote-access diagnostics and controls
- Perform measurement and validation audits on any energy efficiency project
- Fulfill emergency demand response curtailment requests

Energy Council of Canada

Conseil canadien de l'énergie

T: 613 232 8239 E: epc@energy.ca
F: 613 232 1079 W: www.energy.ca

Ottawa
Toronto
Calgary

Submission on the Electricity Supply Mix

to the Ontario Power Authority for the Development of an Integrated Power System Plan for Ontario

July 28, 2005

Murray J. Stewart – President, Energy Council of Canada

October 25, 2005
Toronto

It is a pleasure to provide the Ontario Power Authority (OPA) information in response to its request for submissions on four "issue areas" with respect to the future energy supply mix in Ontario. These four "issue areas" have been developed by the OPA to meet the requirements of the request from the Minister of Energy to the OPA, to begin the process of developing an Integrated Power Systems Plan for Ontario.

The World Energy Council (WEC), formed in 1923, is the sole global body looking at energy in its totality. Its mission is to promote the wise and sustainable supply and use of energy for the greatest benefit of all people. It covers all energy sources and uses, together with energy efficiency and best practices, and conducts extensive research and analysis, typically with a longer term perspective.

The Energy Council of Canada, a founding member, is one of 98 national member committees of the World Energy Council, and is made up of representatives from across the full spectrum of Canada's energy sector, including the federal government and many provincial and territorial energy departments and agencies. As with World Energy Council, it pulls the stakeholders together, to get the facts out, and to advocate action where this is necessary.

Sustainable energy development supports industrial growth and social development. At the 2002 Johannesburg Summit, access to secure, economical and reliable supplies of energy was seen as fundamental to achieving global sustainability.

Canada, and Ontario, are leaders in energy systems, and this has greatly contributed to our sustained economic prosperity.

Overview

I draw your attention to two attached documents prepared by the World Energy Council and the Energy Council of Canada:

- "***Delivering Sustainability: Challenges and Opportunities for the Energy Industry***", World Energy Council Statement 2005.
- "***World Energy Council 2004 Studies***", which summarizes a number of recent global studies.

Oskar Sigvaldason
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Referring first to the "*Delivering Sustainability*" document, sustainable energy systems are achievable, but the challenges are many and need to be tackled urgently, if sustainability is to be achieved in this century. This was the principal conclusion reached by the 19th World Energy Congress in Sydney, Australia last September, the most widely representative triennial gathering of the world's energy decision makers. We endorse these conclusions, but would add that we do not have a century to act! We can and must act now to put energy development on a fully sustainable path as soon as possible. The keys to delivering energy sustainability, are to:

- **Keep all energy options open:** No technology should be idolized or demonized, and energy efficiency must be increased.
- **Ensure the needed investment in energy infrastructure:** For this, cost-reflective energy prices are essential – systems which do not pay for themselves are ultimately unsustainable.
- **Adopt a pragmatic approach to market reform:** This would accommodate market interventions in appropriate circumstances, while designing such interventions to disrupt price signals as little as possible.
- **Place priority on the measures needed to ensure reliability of supply:** Above all, this depends on energy diversity, supported by sound market design and improved generating plant performance.
- **Promote regional integration of energy supply systems:** This further supports reliability and calls for stronger regional collaboration.
- **Exploit the win-win opportunities of emerging climate change responses:** The mechanisms, whether voluntary or regulated, should embrace least cost emissions reduction, encouraging transfer of clean technology from industrialized to developing countries.
- **Ensure technical innovation:** It is vital to reconcile development with protection of the environment, which calls for strong, sustained support for R&D
- **Win and sustain public understanding and trust:** This in turn depends on energy sector transparency and better public information, starting in particular with young people.

No single player in the energy system can act alone: government policies, regulatory stability and clarity, industry investment, society, and the final consumers of energy services all have their individual roles to play.

The World Energy Council has concluded that energy systems which meet the criteria of sustainability are achievable within three decades, if vigorous action is taken.

October 25, 2005

Toronto

The Four OPA "Issue Areas"

This leads to the second document - "***World Energy Council 2004 Studies***" – and the various Studies referenced. A number of these Studies are directly applicable to the four OPA "issue areas" as discussed below.

Issue 1: Assessment of risks, environmental attributes and cost characteristics of various portfolios:

- ***Energy Market Reform: Lessons Learned and Next Steps:*** This Study shows there is a growing recognition that market design must be adapted to each unique situation, and that a simple step by step approach is often best, as

emphasized in this Study. Intervention must be done within the regulatory framework, support cost reflective pricing and provide stability and transparency to attract the necessary investment in a timely manner. Proceeds from the intervention need to be reinvested to achieve the goal of 'sustainable energy systems'

- ***Drivers of the Energy Scene Study:*** While cost-reflective prices must be the guiding principle of energy market design, it is now widely recognised that market interventions (for example, consumer subsidies or taxes) may be needed to achieve essential goals. These may address energy access, security of supply, the internalization in prices of the cost of emissions mitigation and environmental impacts, or to promote R&D and emerging energy sources.

  This Study concentrates on oil and natural gas markets, past GDP and energy trajectories, and the challenges the energy scene faces today. It attempts to address the most important economic, social, environmental and technological issues.

Issue 2: Appropriate approaches to constructing Conservation and Demand Side Management portfolios for inclusion in long term plans:

- ***Energy Efficiency Policies: A Worldwide View:*** On the demand side, increased energy efficiency is imperative, and is potentially a win-win option. This Study confirms that cost-reflective pricing, the incorporation of external environmental costs into prices, and international collaboration and coordination all promote energy efficiency. The Study evaluates energy efficiency policies in 63 countries, looking at five specific policy measures:
  - Minimum energy efficiency standards for household electrical appliances;
  - Innovative energy efficiency funds;
  - Voluntary/negotiated agreements on energy efficiency/CO_2;
  - Local energy information centre; and
  - Packages of measures.
- ***Energy End-Use Technologies for the 21st Century:*** It is urgent for energy research and development to be strongly and consistently supported by governments as well as industry. This is the pre-condition for innovation and is the most appealing way to bridge the gap between global energy needs and sustainability.

  Ideally, technological advances can reduce environmental impact, while also improving cost performance. For this reason, it is just as vital to improve the existing energy sources as it is to provide new 'breakthrough' options. It is also vital for efficiency of energy end-use. The ***Energy End-Use Technologies for the 21st Century Study*** concludes that robust end-use technologies would permit worldwide energy savings of as much as 25% by 2020 and over 40% by 2050.

  Technological advances are unlikely, however, to yield any instant solutions. The timeframe to commercialize technically feasible new technologies which have been proven in the laboratory or at pilot-scale is very long. In the World Energy Council's view, important technology areas such as the hydrogen economy and nuclear fusion are too far into the 21st century to avoid the need for more immediate solutions.

Issue 3: Assessments of different supply technologies and resources in the Ontario setting: All energy supply options must be kept open, including the cleaner fossil fuel systems, nuclear, hydro (whether large or small), and the new renewable energy sources. Each option is subject to significant uncertainties – we cannot afford to jettison any one of them. Moreover, the different sources are often complementary and the best mix to meet expanding needs will depend in part on technological advances, but is also strongly location-specific.

- ***Survey of Energy Resources:*** This Study states that the global resource base is not a constraint to expanded supply, but sharply increased investment is needed in production, conversion and delivery systems. To achieve this, cost-reflective energy prices are essential. Energy systems which do not pay for themselves over the medium to long term are not sustainable. Regulatory frameworks must recognize this and provide stability and transparency to attract the necessary investment in a timely manner.
- ***Performance of Generating Plant: New Realities, New Needs:*** While increased investment in expanded supply is vital, the key conclusion of this Study should also be recognised, namely that significant investment in new capacity per annum can be "saved" simply by improving availability and implementing best practices at existing power plants. Central to this effort are energy prices which, to the fullest extent possible, reflect both the fixed and variable costs of delivered energy services.
- ***Handbook of Renewable Energy Projects:*** This Study goes into further detail on these particular energy options.
- ***Towards Local Energy Systems: Revitalizing District Heating and Cogeneration in Central and Eastern Europe:*** While focused on another jurisdiction, this Study identifies the major challenges facing district heating, and offers practical guidance and possible solutions.
- ***Sustainable Global Energy Development: The Case for Coal:*** This Study goes into further detail on this particular energy option, although in the Ontario context it may be considered a longer term option.

Issue 4: Appropriate methods to assess the impact on the natural environment of supply options:

- ***Comparison of Energy Systems using Life Cycle Assessment:*** This Study identifies all environmental impacts from 'cradle to grave' by primary energy source. Once identified, such impacts should be incorporated into the cost of energy delivered, through policy intervention.

Other Considerations

Supply reliability:

Supply disruptions, whether in developing or industrialized countries carry a heavy price. Measures to improve reliability of supply are an important priority. Energy source diversity, keeping all energy options open, is the bedrock of a robust supply system. Excessive dependence on any one source or supplier is likely to entail vulnerability. Market design which provides for timely investment in renewing and expanding supply and delivery capacity is another key dimension of ensuring supply reliability.

Regional integration of energy systems:

Regional integration of energy supply systems can boost access and energy supply security, and means that demand is met by the nearest available supply source, thus supporting improved access at the lowest possible price. Regional collaboration to harmonize the regulatory framework for energy, and to create the necessary infrastructure, will provide a more attractive base for investment.

Public understanding and trust:

Greater public trust and understanding will be needed to avoid political pressures that risk deflecting governments from delivering energy sustainability. Such understanding depends on an informed public, and calls for energy sector transparency and the provision of better public information.

Energy systems serve the public, but the installation of the needed production and supply capacities requires public understanding to put "not in my backyard" (NIMBY) attitudes in perspective, even if it will not necessarily avoid them.

In addition, if pricing is to be cost-reflective, consumers will be directly affected by the increased energy prices, which the World Energy Council believes likely in the coming decades. For the reasons already discussed, it simply will not work to try to protect the consumer from the cost of environmental sustainability.

Greater public understanding of energy realities may also assist in promoting energy efficiency. Historically price has been the main driver of energy efficiency. Higher real energy prices will bring both a renewed focus on efficiency and benefits for the environment, but again, this calls for an informed public.

In conclusion, the overall challenge for Ontario, as with all other global jurisdictions, may be summed up as delivering sufficient energy for more equitable and secure social and economic development, while avoiding environmental impacts which would compromise the capacity of future generations to enjoy the fruits of that development.

Note: All of the World Energy Council Studies referenced in this submission, as well as the Studies Summary and World Energy Council Statement attached hereto, have been provided to the Ontario Power Authority – both electronically, and in hard copy. Additional copies may be obtained from the Energy Council of Canada.

October 25, 2005

Toronto

Energy Council of Canada

Conseil canadien de l'énergie

608-350 Sparks Street
Ottawa Ontario K1R 7S8

T: 613 232 8239
F: 613 232 1079

E: epc@energy.ca
W: www.energy.ca

Ottawa

Toronto

Calgary

July 28, 2005

Ontario Power Authority
Supply Mix Submissions
175 Bloor Street East
North Tower, Suite 606
Toronto, Ontario M4W 3R8

Dear Sir/Madame:

Re: Supply Mix Submission

I am pleased to respond to your invitation for submissions with respect to the future energy supply mix for Ontario.

The Energy Council of Canada submission is comprised of the following:

- **Submission Report of July 28, 2005**
- **Two Summary Attachments:**
  - *"Delivering Sustainability: Challenges and Opportunities for the Energy Industry"*
  - *"World Energy Council 2004 Studies"*
- **Ten World Energy Council Studies**
  - *Energy Market Reform: Lessons Learned and Next Steps*
  - *Drivers of the Energy Scene Study*
  - *Energy Efficiency Policies: A Worldwide View*
  - *Energy End-Use Technologies for the 21st Century*
  - *Survey of Energy Resources*
  - *Performance of Generating Plant: New Realities, New Needs*
  - *Handbook of Renewable Energy Projects*
  - *Towards Local Energy Systems: Revitalizing District Heating and Cogeneration in Central and Eastern Europe*
  - *Sustainable Global Energy Development: The Case for Coal*
  - *Comparison of Energy Systems using Life Cycle Assessment*

I would be pleased to meet with you to discuss this submission.

Yours sincerely,

Murray J. Stewart
President

416 953-0111 murray.stewart@energy.ca

CANADIAN ENERGY PERSON 2005
October 25, 2005
Toronto

Oskar Sigvaldason
Chair
Murray J. Stewart
President
Andrew Stephens
1st Vice Chair
Marie-José Nadeau
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enersource
Corporation

3240 Mavis Road
Mississauga, ON
L5C 3K1
Tel: (905) 566-2727
Fax:(905) 566-2737

August 22, 2005

Ontario Power Authority (the "OPA")
175 Bloor Street East
North Tower, Suite 606
Toronto, Ontario
M4W 3R8

Attention: Dr. Jan Carr, President and CEO

Dear Dr. Carr;

Re: Call for written submissions, supply mix ("Supply Mix Submission")

Enersource is pleased to submit to the OPA our Supply Mix Submission. We are providing specific recommendations that Enersource believes the OPA should consider in dealing with some of the 4 established "issues areas".

- Appropriate analytical planning approaches that focus on assessment of risks, environmental attributes and cost characteristics of various portfolios;
- Appropriate approaches to constructing Conservation and Demand Management (CDM) portfolios for inclusion in long-term plans;
- Assessments of different supply technologies and resources in the Ontario setting, including but not limited to, natural gas generation, nuclear (new and refurbished), wind, biomass and hydro-electric resources;
- Appropriate methods to assess the impact on natural environment of supply options.

Generally, we believe that prior to purchasing additional supply from new resources, Ontario should first be certain that we have cut back both demand and consumption to the lowest most cost effective levels that can be achieved. In that context, and in conjunction with the Supply Mix Submission, we had delivered recommendations to the OPA on July 28th setting out our recommendations regarding procurement (the "Procurement Submission"). Together, we believe both our Supply Mix Submission and Procurement Submission recommendations represent a comprehensive approach designed to ensure the greatest likelihood of having resources available to meet Ontario needs.

enersource Corporation
3240 Mavis Road
Mississauga, ON
L5C 3K1
Tel: (905) 566-2727
Fax:(905) 566-2737

CDM / LDC purchase obligations

Currently very little turns on LDC forecasts for demand and power, and consequently some LDCs spend very little time, effort and cost in producing accurate forecasts. We believe that LDCs first need to be accountable to deliver accurate forecasts of demand and consumption needs upon which the OPA can build the Provincial need. We believe that one of the OPA's roles is to become an aggregator of forecasts of LDCs, the IESO and others, in the establishment of the Provincial needs, and which also forms the basis for various OPA solicitations for procurement as the gap between supply and demand as known, and as it continues to widen. As such the OPA should, in our opinion, consider mechanisms to ensure acceptable levels for error are provided in all forecasts it aggregates and upon which it is making its purchasing decisions. The OPA should, in our opinion, push the forecasting obligation down and become an aggregator of forecasts.

In concert with an OPA-monitored forecast of demand and consumption, we feel that LDCs should be accountable to deliver a certain threshold of demand reduction, against the OPA's provision of a fixed $ / kW incentive payment (as noted in our Procurement Submission). It is our view that the OPA should establish targets for conservation and demand management ("CDM") applicable to LDCs and market participants. LDCs will track the achievement of their CDM objectives and report those to both the OEB and the OPA. LDCs being offered financial incentives under various OEB regulations for lost revenue adjustment mechanisms ("LRAM") and shared savings adjustment mechanisms ("SSM") will ensure that LDCs provide to the OPA the greatest amount of CDM attainable. Once the forecast for the following year has been established, we again believe the OPA and or the OEB should establish a mechanism of rewards and penalties for those LDCs who do or do not achieve the CDM expectations as well as an incentive mechanism for overachieving on CDM targets.

In the area of demand reduction, we also note that since Ontario has no true capacity market, establishing programs in the absence of the OPA providing a dollar / MW for such demand reduction will limit the development of this market.

As an example, Enersource believes that the aggregation and dispatch of existing back up generation ("BUG") should be a focus area of demand reduction for LDCs, assuming environmental regulations are amended and the OPA offers a value for that capacity. This is currently not working at all in Ontario; in fact it is working in a contrary manner. For example, where the IESO initiates a voltage reduction, in many cases this causes many end users to start their back up generation for various power quality and power availability certainty issues (in other words, the generators are starting up after the fact because of the IESO's decisions to reduce voltage. As a result, the decision to purchase

enersource Corporation
3240 Mavis Road
Mississauga, ON
L5C 3K1
Tel: (905) 566-2727
Fax:(905) 566-2737

power from the interconnected markets is being done before dispatching all available domestic resources).

We believe that what should be occurring is prior to initiating voltage reductions or out of Province purchases of expensive power, we should first dispatch BUGs under some coordinated fashion with LDCs and end users and paying a price that is representative of the value this brings to the system. Again, we note this under the DR / LDC section of our submission as the system impact of dispatching BUG is exactly the same as demand reduction, and in our view should be treated as such, in priority before the purchases of higher price power or voltage reductions, and certainly before power contracts are signed to cause parties to invest new capital for capacity.

Given that demand and consumption reduction provide the added benefit of no negative environmental attributes, and typically they have the added benefit of reducing costs to all ratepayers participating, this should hold a very high priority rating in the OPA as it considers establishing its "supply mix". In other words, although an annual target should be agreed to based on circumstances at the time, there should never be a situation where economic MW or MWh of CDM are "disallowed" because a certain target is achieved. The bottom line is if economic CDM can be provided in the context of the guidelines stated, there should always be an acceptance.

As the OPA reviews the possible attainment of targets and objectives in different areas, it is Enersource's view that with the right "delta" between on and off peak rates and use of programs such as BUG demand reductions at the LDC level are critical to the achievement of those objectives. We think the OPA needs to give this important element of the supply mix serious consideration.

Generation

The key message we offer in the area of Generation in the context of supply mix recommendations is to target a high degree of diversity. Not only in terms of generation fuel source, but also in the context of central plant versus distributed generation.

Specifically, we feel the OPA needs to play a greater role in the establishment of more distributed generation versus the development of only large central plants located long distances from the loads they serve. Further in our Procurement Submission we note that the OPA needs to pay distributed generation a value commensurate with the quantifiable system benefits those generators bring (this is consistent with the final recommendations in the ECSTF).

enersource Corporation
3240 Mavis Road
Mississauga, ON
L5C 3K1
Tel: (905) 566-2727
Fax:(905) 566-2737

As the OPA considers the need to establish MW targets in various areas for supply mix, we think there is a need to "take a step back" and first establish a Provincial objective of ensuring a greater percentage of generation is located within proximity to loads. This is of critical importance in large urban areas such as the GTA, where there is a huge dependence upon transmission, and therefore significant risk due to transmission outages or as a result of shortages of capacity in other parts of the Province. Further, should we ever encounter a Province-wide problem like a black-out, the ability and time necessary for the system to recover is significantly shortened if we break down our Provincial supply portfolio into smaller increments of more local generation and distributed generation.

We specifically believe that a transition to a greater proportion of distributed generation meets the planning criteria set out above, with the added benefit of helping to mitigate the NIMBY phenomenon occurring in the area of approvals for generation to be procured under the previous Provincial RFP. Where good distributed generation projects can be developed in a way that delivers a greater proportion of the benefits to the local community in the areas of system support or supply of thermal energy to local business and industry, there is a stronger likely-hood of local support rather than opposition.

As we look to other forms of generation and larger plants, again, the need to diversify is critical. We need to contract for nuclear capacity, hydroelectric capacity, distributed generation, renewables and gas -fired generation in aggregate to meet the needs. As Ontario endeavors to re-establish investor confidence in the Ontario electricity market, we believe the Province should reconsider its plans to invest in expensive transmission lines to neighboring utilities to permit them to build non-domestic capacity to meet our needs. This reduces investor's confidence in the Ontario electricity market, and puts Ontario at greater supply risk by virtue of decisions taken in other provinces. Our preference is that this Provincial investment be made in a way that encourages domestic generation first, and only after those resources are exhausted, consider looking elsewhere.

The issue of supply mix is complex. We believe the Province needs to establish targets in the areas of percentages of different fuel sources, distributed generation versus large central plant, and coordinate that with Transmission and Distribution needs. As we consider supply mix and the need to add generation we also get drawn into discussions on upgrades of transmission and distribution, who pays the costs to modify these systems to accommodate new sources of supply, and the implications on existing non-contracted resources. In order to keep our Supply Mix Submission as brief as practicable we have not attempted to address all of the other issues that must be considered.

enersource Corporation
3240 Mavis Road
Mississauga, ON
L5C 3K1
Tel: (905) 566-2727
Fax:(905) 566-2737

Enersource remains committed to support the Province and the OPA in the achievement of objectives designed to strengthen Ontario's electricity industry. We would be pleased to respond to any questions the OPA may have in respect of this or other submissions made by Enersource.

Sincerely,

Barry Chuddy
Executive Vice President,
Business Development and Marketing.

c.c. Gunars Ceksters, CEO
Roland Herman, COO
Carmine DiRuscio, Chief Conservation Officer

Dear OPA

I would like to recommend that Ontario adopt a renewable energy tariff similar to what Germany and Washington State have as this allows the public basically to fund the capital cost of adding solar-PV/wind/micro-hydro/biomass grid tie electricity systems to the grid providing power. This will help with the goal of 60% renewables by 2020.

Regards
Steve Eng, P.Eng.

My suggestion is that wind power be a major thrust for future electrical power generation. Additionally, I believe that new nuclear generators must be built. Voluntary conservation will not work to close the energy gap (Demand minus generation). Fossil fuel generation produces too many pollutants.

Sincerely,
Janis Epners

Submission on Future Supply Mix by GE Energy

Executive Summary

The challenges facing Ontario in the power sector -- aging and inadequate power generation and transmission systems, populations that are concerned about global warming and other environmental issues, limited natural energy resources – are serious but not unique. GE, as a major supplier of power equipment and services in countries around the globe, is active in markets facing similar challenges to those of Ontario and is aware of or developing solutions which may have application in Ontario.

The technology exists for Ontario to achieve its peak shaving and energy reduction targets of 5% in 2007 and 10% in 2010 respectively. Advanced metering devices can support automatic energy management decisions at the consumer level and more efficient central management of energy consumption by system operators. These functions can be integrated with real-time or time-of-day market pricing to enable greater economic efficiency as well. Technology alone will not change consumer habits. Economic incentives which encourage the application of the technology for reducing energy consumption and peak shaving are required as well.

A power system as large and complex as Ontario's requires a mixture of base load, intermediate load and peaking capacity to satisfy changing daily and seasonal needs economically and effectively.

Base load generation typically provides the lowest cost generation. CANDU nuclear power has played a leading role in providing Ontario's base load power. With the increasing importance of reducing GHG emissions, nuclear power - which has no GHG emissions - can be expected to continue to play an important part in Ontario's electric future. GE Energy is developing advanced nuclear generation and is also supporting the continued operations of today's nuclear fleet including the CANDU design.

Integrated coal gasification combined cycle (IGCC) technology such as GE's IGCC achieves emissions that are one-half or less than conventional combustion coal plants. While Ontario has expressed its intent to phase out its existing coal-fired generation facilities, this should not preclude the use of cleaner coal-based generation which can provide economic power supply options for Ontario's near-term and long-term supply mix planning.

High efficiency Combined Cycle gas turbines have short construction cycles and feature rapid response load following and peak shaving capabilities. The recent price volatility in Ontario's wholesale energy market demonstrates the importance of having flexible, efficient, and economic peaking and intermediate generating capacity.

Renewable energy in the form of hydro power has historically been a pillar of Ontario's power development. Renewable energy is again a priority as per Ontario's current goal of obtaining 5% of energy from renewable sources by 2007 and 10% by 2010.

Wind is expected to play a major role in meeting the renewables commitment. Ontario has virtually no wind generation today, but through the recent Renewables RFP I has committed to build some 300 MW of wind turbine projects. Moreover, wind is expected to be the option of choice for most of the 1000 MW of Ontario's Renewable RFP II. GE Energy is a major supplier of wind turbines today and is developing "next generation" multi-MW wind turbines to further improve the economics of this renewable source. Offshore wind generation in Lake Erie should be considered as well as on-shore locations.

The intermittent (non-dispatchable) nature of some renewable sources, however, makes it important that these technologies be approached from a system-based perspective. Studies performed by GE Energy for New York State Energy and Research Development Authority (NYSERDA) showed that at least 3,000 MW of wind generation could be accommodated without major perturbation of system operations.

Perhaps a bit more distant, but almost certainly within the 20-year horizon of Ontario's long-term plan, is the commercial deployment of other advanced generating technologies. The cost of solar generation continues to decrease and applications in residential and commercial buildings are increasing; more and more experience is being gained with fuel cell applications; and energy storage technology research continues to explore more efficient options.

Also, although not specifically addressed in the request for written submissions, consideration should be given to the adequacy of the transmission and distribution system. Central station generation depends on transmission. It is important that the cost and feasibility of transmission upgrades be considered along with the cost of the generation itself in evaluating different supply mix strategies. Advances in transmission and distribution technologies that can increase the reliability and throughput of existing systems can enable additional efficient generation. In addition, upgrading transmission control technologies can both improve system reliability and enable more efficient utilization of existing generation resources. Wide area measurement, advanced state estimation, substation automation, condition diagnostics, and other rapidly advancing technologies can significantly improve transmission system operations.

Strengthening the inter-provincial transmission lines to Manitoba and Quebec would have the added advantage of enabling increased power imports to Ontario from low cost neighbouring jurisdictions, and of facilitating the development of additional hydro capacity, particularly in Manitoba.

While it is impractical to submit a full list of possible supply-mix options and their characteristics with these comments, GE Energy would welcome the opportunity to work with OPA and its consultants in reviewing the list of supply options being considered, to improve the characterization of these options where appropriate as well as to identify other options that may not yet have been considered.

Introduction

GE Canada is pleased to have the opportunity to respond to the Ontario Power Authority's request for comments on developing a planning approach for the future "supply mix" in Ontario. The challenges facing Ontario in the power sector -- aging and inadequate power generation and transmission systems, populations that are concerned about global warming and other environmental issues, limited natural energy resources – are serious but not unique. GE, as a major supplier of power equipment and services in markets around the globe, is active in markets facing similar challenges to those of Ontario and is aware of or developing solutions which may have application in Ontario.

GE is itself concerned about global warming and sustainability, and has established "ecomagination" as a new core thrust. This program has three anchors: investment in energy efficient projects; development of new forms of "green energy"; and reduction of emissions at GE facilities. The new "green energy" solutions are in various stages of development: some are at the research stage; some are pilots; some are demonstration projects; and some are entering the commercial market.

GE offers the following comments specifically addressing the areas requested in OPA's call for written submissions.

Energy conservation and demand management (CDM)

Energy conservation and demand management (CDM) is an appropriate part of a long-term energy plan. Ontario currently has a target of reducing peak demand by 5% by 2007. Economic forces can help achieve this goal. Currently, many consumers do not pay the full cost of the energy they consume, nor are they even aware of that cost. It is interesting to note that there are 900,000 apartments in the Greater Toronto Area that are not metered and for which the apartment owners, not the renters, pay for the power. Studies have suggested that metering the consumption and having the tenant pay for the consumption would reduce consumption by about 10%.

Advanced metering infrastructure technologies are evolving that enable more efficient information exchange and more effective energy consumption decisions than previously possible. Metering, in this case, goes far beyond the traditional measurement of integrated monthly consumption of electricity. The use of modern devices and processes can now support automatic energy management decisions at the consumer level and more efficient central management of energy consumption by system operators. These functions can be integrated with real-time or time-of-day market pricing to enable greater economic efficiency as well.

Increasing global demand for basic fuels is causing escalating prices that are driving up the cost of electricity. Conservation is more economically attractive than ever before. Advancing communications, monitoring, and control technologies make capabilities once thought of as being too costly for wide-spread application much more approachable. It is likely that this trend will continue in the future. Consequently, the economic incentives for reducing energy consumption and peak demand will increase in parallel with the ability to implement technology to achieve these goals. OPA's long-term plan should specifically address both the potential for introducing market signals to increase voluntary conservation and peak demand shifting and increasing the ability of the system operators to control demand when necessary.

Renewable energy

Renewable energy, historically a pillar of Ontario's power development, is again becoming a mainstream source of energy. Further expansion of hydroelectric generation, which has long

been a major component of Ontario's energy mix, is however limited as most of Ontario's economic hydro potential has already been developed. GE Energy is a global leader in the supply of hydro electric generation equipment including that for Hydro Quebec's James Bay development.

Wind generation is becoming an increasingly important part of a diverse energy supply mix in many countries worldwide. GE Energy is a major global player in the wind turbine market which today has global sales totaling $10 billion and increasing rapidly.

Advances in solar energy are also making this technology much more attractive than ever before.

The increasing cost of basic fuels, as noted above, coupled with increased sensitivity for environmental impacts, are driving rapid advancements in renewable technologies generally. Ontario's current goal of obtaining 5% of energy from renewable sources by 2007 and 10% by 2010 is a clear statement of this trend.

The intermittent (non-dispatchable) nature of some renewable sources, however, makes it important that these technologies be approached from a system-based perspective. Studies performed by GE Energy for New York State Energy and Research Development Authority (NYSERDA) showed that at least 3,000 MW of wind generation could be accommodated without major perturbation of system operations. GE is currently beginning a study to determine what, if any, actions would be necessary to enable even greater levels of wind deployment in California. As additional experience is gained with operating wind and other non-dispatchable generation, it is likely that technologies will evolve that further expand the ability to the system to accept renewable generation.

Generation Mix

A power system as large and complex as Ontario's requires a mixture of base load, intermediate load and peaking capacity to satisfy changing daily and seasonal needs economically and effectively.

The ideal generation mix for a system is impossible to predict perfectly given the range of uncertainties that drive both energy demand and the relative merits of different supply sources. The daily and seasonal variation in power demand, along with the requirement to match that demand in real time, makes a mix of baseload, intermediate, and peaking generation appropriate. Traditional system planning has often selected the mix of generation that minimized the total cost of serving demand. More advanced forms of integrated resource planning have included consideration of environmental and other externalities. Scenario analyses are typically used to test the robustness of different strategies given the large uncertainties that apply over any reasonable planning period. We've provided additional comments below regarding different supply technologies. In any case, however, the selection of the generation mix should consider the flexibility inherent in each supply option as well as its "expected" performance. This may well lead to a different ideal mix among baseload, intermediate, and peaking generation than might emerge if a more simplistic view of performance is used to characterize the options.

Issue Area #1:

> Appropriate analytical planning approaches that focus on assessment of risks, environmental attributes, and cost characteristics of various portfolios. The approaches will be of the greatest value where they include assessments of the risks that could affect portfolio performance, including financial, market, environmental and other quantifiable and qualitative risks.

Performing a thorough analysis of potential strategies in terms of risks, environmental attributes, and costs is a daunting task. Production simulation tools, like GE Energy's MAPS (multi-area production simulation) software, can be used to predict system operations and the resulting costs and environmental impacts. These tools, however, tend to be deterministic analyses based on a specified set of conditions (loads, fuel prices, environmental values, etc.). It is difficult for such models to fully capture the value of deferring decisions, although this is an important factor in assessing risk. The approach selected should specifically address this value, along with the ability to adapt any previous decisions to changing conditions. Flexibility is often much more valuable in reality than it appears to be in the planning process.

There are a number of individual attributes that affect the cost. Perhaps the most sensitive of these, at least within today's environment, is the cost and availability of fuel. Scenario analyses may provide a useful way to look at the ability of different potential supply strategies to accommodate different future conditions. The analysis is useful even if probabilities of occurrence are not assigned to each scenario. It is important, however, to be sure that each scenario is internally consistent.

Issue Area #2:

> Appropriate approaches to constructing CDM ("Conservation and Demand Management") portfolios for inclusion in long-term plans. These approaches will be of the greatest value where they include established data on technical and achievable potential, costs, implementation barriers, sector specific characteristics, experience in implementation of CDM, and technology developments.

Conservation and demand management (CDM) programs are increasing in popularity, maybe in part because of the range of programs that are being tried. Traditional demand-side management has often taken the form of interruptible loads where service to some consumers is suspended to support system operations in exchange for some reduction in electricity price. These programs require consumers to make choices based on limited information and to give up control in advance. Consequently, consumers often express considerable dissatisfaction when service is actually suspended.

A significant reduction in demand could be achieved by having consumers pay the full cost of power. GE has developed technology that can provide real time price signals for all Ontario consumers. This technology would cost less to introduce than the alternative of adding capacity, transmission and distribution. Furthermore the technology exists for "smart meters" to manage automatically and remotely power consumption within a house, apartment, or business; e.g., to turn down air conditioners and appliances during high cost periods, and so on. Ontario has stated its intention on many occasions to make smart meters mandatory – but has never pulled the trigger. Introduction of Real Time Pricing and an advanced metering infrastructure ("smart metering") could go a long way to take some pressure off the requirement for new generation and transmission capacity. In addition, increasing electricity production costs, increasing environmental sensitivity, and decreasing technology costs are combining to make these applications much more attractive to consumers.

As noted above, price signals can provide a strong significant incentive to reduce or shift consumption; an advanced metering infrastructure can make responding to these signals automatic and largely painless.

Issue Area #3:

> Assessments of different supply technologies and resources in the Ontario setting, including (but not limited to) natural gas generation, coal gasification, nuclear (new and refurbished), wind, biomass and hydroelectric resources. The assessments will be of the greatest value where they (1) utilize recent source information or current data on capital and operating costs, performance characteristics, technology life cycle, environmental impacts and any other relevant characteristics and (2) present data on a consistent basis across supply technologies and resources that would be suitable for planning studies.

Baseload generation is typically designed to achieve the lowest cost generation, usually by reducing operating expense through additional capital investment. The high capital costs associated with baseload generation make consideration of long term fuel price and availability issues very important. It is also critical in looking at baseload generation to consider the ability to adapt to evolving environmental requirements.

CANDU nuclear power, with its low and stable operating costs, has played a leading role in providing Ontario's base load power. With the increasing importance of reducing Green House Gas (GHG) emissions, nuclear power - which has no GHG emissions - can be expected to continue to play an important part in Ontario's electric future. GE Energy is continuing to develop advanced nuclear generation as well as supporting the continued operations of today's nuclear fleet including the CANDU design. GE Energy's Advanced Boiling Water Reactor (ABWR) is operating today. The next generation Economic Simplified Boiling Water Reactor (ESBWR) represents a major advance in the technology that further improves safety while reducing capital and operating costs. We expect the initial deployment of the ESBWR to occur well within the OPA planning horizon. It is important to ensure that the plan is developed in a manner that will incorporate such technologies once they are available.

GE Energy is also commercializing integrated coal gasification combined cycle (IGCC) technology to allow continued utilization of coal, an abundant and indigenous fuel source in many parts of the world, while greatly reducing the environmental impact. In addition to achieving emissions that are one-half or less than conventional combustion coal plants, IGCC is particularly well suited for carbon capture. It is ready to serve as a key component in reducing greenhouse gas emissions while still enabling utilization of coal as a fuel source. In addition, IGCC provides a greater degree of fuel diversity than present in most traditional coal-fired power plants. We believe that providing flexibility to adapt to changing requirements and conditions is an important attribute for all generation and that the "option" value presented by such flexibility should be explicitly considered in long-term planning. While Ontario has expressed its intent to phase out the existing coal-fired generation facilities, this should not preclude the use of cleaner coal based generation, like IGCC, in both near-term and long-term supply mix planning.

Construction cycle time, fuel efficiency, and operating flexibility are taking on increasing importance with many of our customers. GE Energy has responded by leveraging the operating flexibility of previously commercialized products such as the 7FA gas turbine Combined Cycle plant into its large, high efficiency, 7FB and 7H Combined Cycle designs. In addition, GE Energy has developed the LMS 100, a hybrid of aero derivative and large frame gas turbines that combines many of the most desirable features of both. Most long-term planning models have difficulty valuing flexibility. Our customers' message, however, is clear: flexibility is very important even if difficult to value economically. It is appropriate to include the system operators' perspectives in evaluating generation mix decisions. Recently observed price volatility in the wholesale energy market further demonstrates the importance of having flexible, efficient, and economic peaking and intermediate generating capacity.

Renewable generation is expanding worldwide. Ontario has virtually no wind generation today, but through the recent Renewables RFP I has committed to build some 300 MW of wind turbine

projects. Moreover, wind is expected to be the option of choice for most of the 1000 MW of Ontario's Renewable RFP II. GE Energy is a major supplier of wind turbines today and is developing "next generation" multi-MW wind turbines, further improving the economics of this renewable source. Offshore wind generation in Lake Erie should be considered as well as on-shore locations.

Perhaps a bit more distant, but almost certainly within the 20-year horizon of Ontario's long-term plan, is the commercial deployment of other advanced generating technologies. The cost of solar generation continues to decrease and applications in residential and commercial buildings are increasing; more and more experience is being gained with fuel cell applications; and energy storage technology research continues to explore more efficient options. While it may not be possible to develop a firm plan for incorporating these generation options at this time, the plan should be built such that incorporating these options in the future is not precluded.

While it is impractical for us to submit a full list of possible supply-mix options and their characteristics with these comments, GE Energy would welcome the opportunity to work with OPA and its consultants in reviewing the list of supply options being considered, to improve the characterization of these options where appropriate, as well as to identify other options that may not yet have been considered.

Also, although not specifically addressed in the request for written submissions, consideration should be given to the adequacy of the transmission and distribution system. Central station generation depends on transmission. It is important that the cost and feasibility of transmission upgrades be considered along with the cost of the generation itself in evaluating different supply mix strategies. Advances in transmission and distribution technologies that can increase the reliability and throughput of existing systems can enable additional efficient generation. In addition, upgrading transmission control technologies can both improve system reliability and enable more efficient utilization of existing generation resources. Wide area measurement, advanced state estimation, substation automation, condition diagnostics, and other rapidly advancing technologies can significantly improve transmission system operations.

Again, although improving the transmission system does not fall within the more limited scope of supply mix planning, it is inextricably linked to the overall ability of the system to achieve its mission. Supply mix planning should be performed in conjunction with transmission and distribution planning, not as a separate exercise.

Importantly, strengthening the inter-provincial transmission lines to Manitoba and Quebec would have the added advantage of enabling increased power imports to Ontario from low cost neighbouring jurisdictions, and of facilitating the development of additional hydro capacity, particularly in Manitoba.

Issue Area #4:

> Appropriate methods to assess the impact on the natural environment of supply options. The methods will be of greatest value where they are: (1) methodologically suited to long-term planning; (2) provide for identification and quantification of relevant environmental factors for assessment; (3) capture the cumulative environmental impacts; and (4) provide indications of the sustainability of options and supply mix plans.

Environmental impact is an important consideration in selecting supply options. In theory, it would be best to internalize the value of environmental effects so that they can be incorporated into the economic analysis directly. In practice, however, this is not easy since there are no commonly accepted measures for overall environmental impact. The amount of emissions, water consumption, and solid waste production can be estimated for different supply mix

strategies using production simulation software. It is important that these analyses be done on a system basis since the introduction of a new generation source can reduce the impact of an existing resource. GE Energy is committed to providing generation options that reduce the environmental effect from each generation technology class including developing the most efficient gas turbine based generation. An example of this is the launch of the 7H design in North America by GE Energy and Calpine. Substituting 7H technology for F-Class technology can increase plant output by 15% and improve fuel efficiency while maintaining compliance with the strict California emissions requirements. Commercialization of the Integrated Gasification Combined Cycle technology allows similar environmental benefits to be obtained from coal-based generation.

As noted previously, however, evaluating the supply mix from an environmental perspective should also include an assessment of the ability of each supply mix option to adopt new environmental control technologies in the future. Specifically, the ability of coal-fired generation to use carbon sequestration technology should be considered.

Concluding Comments

GE welcomes OPA's recognition of system planning as an essential element in assuring electrical system adequacy and supporting overall policy objectives. Today, more than ever, uncertainty and risk characterize the planning process.

As a major supplier of equipment to the global power sector, GE Energy is active in markets around the world and on constant watch for new solutions to changing power needs in diverse markets. GE is a leader in many technologies including hydro electric, nuclear, gas turbines, coal gasification, wind generation, power system design and operation, and advanced metering.

GE Energy recognizes the complexities presented in maintaining and expanding critical services to an ever more demanding customer base. In combination with GE Energy Financial Services, GE Energy is helping customers worldwide to develop and implement the solutions necessary for success in an ever-changing world.

GE Energy would welcome the opportunity to work with OPA and its consultants in reviewing the list of supply options under consideration, to improve the characterization of these options where appropriate, as well as to identify other options that may not yet have been considered.

Subject: Electricity Path for Ontario

I understand that the OPA is seeking input from the public on future power sources. I would like to add my comments:

I believe that first and foremost, energy conservation should be a major part of the future scenario. I see at my workplace all kinds of energy wastage.
For example, it is so easy to turn off computers, appliances, etc.
at the end of the work day, but most people still don't do it.
A change in attitude and culture, as well as making electricity more expensive, is necessary,
but I am certain it can be done with the political and public will.

Secondly, renewable energy, such as wind and solar, should provide 60% of electricity.
I see many excellent sites for wind in rural areas surrounding cities.
At the same time this would be a good way to supplement farm incomes (by allowing farmers to rent land for small wind farms).
We also need to promote hydrogen fuel cells to power homes.

I understand you are phasing out coal and I commend you for this.
Nuclear power should also be phased out.
It is too expensive and although the risk of a major disaster is very low,
the consequences of one are too great to bear.
In addition, there will always be the problem of storage of radioactive waste.
The costs of nuclear power, when they include the costs of accidents and dealing with the waste, are unacceptable to society.

Thank you for the opportunity to comment.

Helen Gerson

Ladies/Gentlemen,

Suggestions:-

1. Energy efficiency is first and foremost. See:- "Natural Capitalism" by Hawken, Lovins and Lovins. This is full of case studies, websites, etc., of organizations that have reduced enrgy consumption and made money doing it.
Also "Factor Four" by Ernst von Weizsacker, Lovins and Lovins. More of the same, but more about Europe and International.

2. Reduce speed limits to 90 kph on 400 Highways. This will reduce emissions by approx 20%, save hydrocarbon fuels and reduce smog and health costs.

3. Forget nuclear. It is too expensive, takes too long and, because of the huge capital costs, prevents more efficient, cheaper methods from being used.

4. Wind, small hydro, trees, green rooves (roofs?), natural lighting, better insulation, R-2000 buildings, better building codes, solar hot water heaters, (we have had solar panels on our roof since 1977. They save a bundle!) Clotheslines, windows that open for natural ventilation.

5. Almost all buildings - commercial, condos, etc., need to have ledges over windows to prevent the high, hot summer sun from reaching the windows. Once the heat has penetrated the window glass shutters and blinds don't help. Better low-E windows would help. In winter advantage of the lower sun should be taken - passive solar heating.

6. Photo-voltaics. This method is becoming more and more applicable, especially for remote locations.

7. Street lighting. All new street lighting should be of the full cut-off variety so that light is not wasted shining up into the sky. This prevents unnecessary lighting of the sky (a complaint of astronomers worldwise) and saves energy. Calgary is replacing all their street lighting to follow this trend. Also LED traffic lights and other lights where possible.
Existing lighting should be replaced by energy efficient full cut-off on and ongoing basis.

This is a brief list of the hundreds of things that can be done NOW with existing technology.

Sincerely,

Jack Goering

Subject: energy mix for Ontario's future

Dear Sir:

Thank-you for asking for the opinions of taxpayers and energy-users of Ontario regarding how to satisfy the energy needs of Ontario in the future.

If our residents are allowed to continue their wasteful, profligate uses of energy, it will become impossible to satisfy their needs in the future. Therefore, our first priority must be to reduce demand through the encouragement of conservation, in every way possible: rewards for corporations that reduce their energy needs; rewards for manufacturers that reduce the energy needs of their products; and rewards for consumers that conserve.

The easiest way to initiate such a rewards system is through a steady increase in the cost of energy, and a graduated cost structure that sells energy more cheaply to those who use the least, and most expensively to those who use the most.

It's a fools' game to build more unsustainable sources of energy to satisfy future needs; we would just be using up those limited resources faster, creating more severe problems in the future. All new sources of energy must therefore be from renewable resources.

Unfortunately, nuclear energy has not proven itself to be the answer. Long experience with it has shown that nuclear energy production is unsustainably expensive, and carries environmental risks that scientists have still not succeeded in managing adequately. The Ontario government has been hiding the true costs of nuclear energy for decades. Please consider all the costs to future Ontario taxpayers before deciding to put all our eggs into a radioactive basket!

I hope that my opinions have been expressed clearly, and will be considered before such important decisions are made.

Yours truly,

Bette-Ann Goldstein

Re OPA Submissions for Ontario's energy mix.
I believe that Ontario's energy mix should include Nuclear, hydraulic, Thermal(coal), and renewables. To eliminate any one fuel source will weaken Ontario's economic position and place a great burden on both our elderly on a fixed income and our ability to compete industrially. Ontario's coal fired plants can be made to operate in an environmentally friendly way as evidenced by the clean coal technology already installed at Lambton Generating Station units 3 & 4. Ontario has historically been a net exporter of power but recently has become a net importer of power. This must stop. We must become self sufficient in our energy needs and even more importantly, we must not give up our publicly owned system to privately owned and foreign companies. Renewable sources have a role to play but to rely on them to provide base load power is a scary proposition. Therefore I believe that all Ontario's coal fired plants should be equipped with clean coal technology similar to Lambton G.S.

I look forward to hearing from the OPA regarding this submission.

Regards

Mark Grant

Dear Sir/Madam:

I understand that the OPA is currenlty reviewing the power supply mix for Ontario.

I believe it is very important for the OPA to include a strong conservation and renewable power scenario in its analysis. Ground-breaking research conducted by the Pembina Institute indicates that it is quite possible for Ontario to get 60% of its electricity from renewable sources by 2020 while eliminating dirty coal and nuclear power.

Please include a scenario with a minimum of 60% renewable electricity by 2020 and a full phase-out of dirty coal and unreliable nuclear power.

Thank you

Sincerely
D. Green

cc Sandra SEP 14 2005
C.C. A. Shalaby
Amir
I have copies
our last
correspondence
from Jan +
Dr Greening
Lou

To:

Mr. Jan Carr
Chief Executive Officer
Ontario Power Authority
175 Bloor Street East
North Tower, Suite 606
Toronto, Ontario
M4W 3R8

From:

Dr. F.R. Greening
12 Uplands Ave.
Hamilton
Ontario
L8S 3X7

Tel: 905-317-4544
Greening@sympatico.ca

September 12th, 2005

Dear Mr. Carr,

In my August 28th submission to the OPA I addressed the question of new electrical generating capacity for Ontario and argued that the CANDU reactor should *not* be considered as a viable option for this Province because of design features that have led to unacceptable performance in so many Units at Pickering "A" and Bruce "A".

Atomic Energy of Canada, (AECL), the designer of first generation CANDUs, has in the works a number of new reactors, described as "advanced" or "next generation" CANDUs. AECL is promoting "advanced" CANDU reactors as the best possible solution to Ontario's ever-worsening electrical energy deficit. Certainly these new reactors, such as the highly publicized ACR-700 , look wonderful on paper; however, they are still at the design stage, existing only on paper or in the minds of AECL engineers, and remain experimental and unproven in conception.

The truth is that Ontario in the year 2005 cannot afford the luxury of once again dabbling in unproven nuclear reactor technology in the way it did back in the early 1970s, especially since "first-of-a-kind" reactors are known to involve higher than average OM&A costs. What is more, as I intend to show, the "advanced" CANDU reactor being offered by AECL still has most of the design flaws that plagued Ontario's original fleet of power reactors. Worse yet, the history of CANDU reactor performance strongly suggests that latent design flaws lie hidden in AECL's new designs.

So, let us consider the design of an advanced CANDU reactor such as the ACR-700 in some detail. First it should be stated that even AECL admit that the ACR-700 is based on the well-known CANDU-6 design, as exemplified by the Unit at Point Lepreau. Significantly, most of the "improvements" in the CANDU-6 design - changes that no doubt prompted AECL to use the catchy name "advanced reactor"- involve the troublesome systems and components that are notable for being so complex and unreliable in first generation CANDUs. The offending systems and components, which were described in detail in my August 28th submission, are the D_2O coolant and moderator, the zirconium alloy pressure tube and fuel channel assemblies, the annulus gas and the steel feeder pipes carrying coolant to and from the reactor core. These systems and components, *which are completely absent from other reactor designs*, are considered in detail below.

D_2O Coolant and Moderator

A CANDU-6 reactor requires about 450 tonnes of heavy water (D_2O), valued at about $250 million. The use of such large amounts of very costly D_2O is a problem in itself, but it is made far worse by the neutron activation of deuterium resulting in the production of radioactive tritium in a CANDU core. The need to minimize D_2O loss and tritium emissions leads to elaborate and expensive liquid collection and water vapor recovery systems in all CANDU plant.

The ACR-700 design manages only a partial solution to this problem by substituting light water for the heavy water coolant, *but leaving the moderator D_2O unchanged.* This reduces the total inventory of D_2O by more than 50 %, saving over $100 million. However, this ACR-700 design "improvement" does nothing to reduce the production of tritium in the moderator, which is by far the largest source of tritium in a CANDU reactor. A moderator vapor recovery enclosure is still required in the ACR-700 design together with the associated high capacity dryers.

But this is not the end of the story.... Replacing a portion of a CANDU's inventory of D_2O with H_2O comes with a significant cost to the neutron economy of the reactor. This problem is overcome through the use of *enriched uranium fuel*. The fact that an ACR-700 reactor needs enriched, rather than natural, uranium oxide fuel has a three-fold negative impact on its operation, particularly in Canada:

(i) Enriched fuel is about twice the cost of natural uranium fuel.
(ii) Because no U enrichment facilities exist in Canada, enriched fuel will have to be manufactured and shipped from outside this country. Thus the ACR-700 loses the "homegrown" appeal of its predecessor.
(iii) Production of 1 tonne of advanced CANDU fuel will produce 2 tonnes of highly undesirable *depleted uranium waste*.

Pressure Tubes

The ACR-700 design requires 292 pressure tubes compared to the 380 used in a CANDU-6. Pressure tube problems have plagued CANDU reactors since the early days of Pickering NGS in the mid 1970s. These problems have been largely caused by hydrogen isotope (H or D) embrittlement and irradiation-induced deformation. The CANDU Owners Group, (COG), have collectively spent over $100 million on pressure tube research and development in the past 20 years but achieved only marginal improvements in pressure tube performance.

Because of this situation, AECL are faced with an almost endless list of options to produce the best possible pressure tube for the ACR-700. These options include changes in the manufacturing process such as the extrusion, heat and surface pre-treatment of the pressure tube as well as strict control of alloy impurities such as H, C, P and Cl. These impurities need to be kept to a minimum concentration because they are suspected of playing a role in zirconium fracture toughness, hydrogen pickup and neutron-induced deformation. Unfortunately these impurities also appear to exhibit synergistic effects in the presence of other impurities such as Fe. It is therefore difficult to predict the in-reactor behavior of pressure tubes, especially their deuterium pickup, which is often observed to be highly variable even for ostensibly similar tubes.

AECL argue that pressure tubes exhibiting high deuterium pickup are not a major concern because they are identified through regular inspection campaigns and are replaced before they compromise reactor safety. However, time, cost and radiation dose constraints associated with the inspection procedures, mean that only a limited selection of pressure tubes are ever subjected to hydrogen or deuterium sampling, and the measured concentrations are generally very approximate due to problems with sample contamination and hydrogen isotope migration.

And on a final note, AECL acknowledges that the ACR-700 will require *a full pressure tube replacement* about halfway through its predicted lifespan. Thus pressure tubes remain problematic and potentially life limiting even for "advanced" CANDU reactors.

Feeder Pipes

Recognizing that carbon steel feeder pipes in first generation CANDU reactors have been prone to serious wall thinning from flow accelerated corrosion, AECL specifies stainless steel feeders for its "advanced" CANDUs. There appears to be sound experimental evidence that stainless steel feeder pipes will perform better than carbon steel feeders; nevertheless feeder pipes in an ARC-700 reactor will still be subject to regular inspection under CSA N285.4, (or equivalent), the Canadian standard for nuclear pressure boundary materials. The accessibility of center-core feeders to inspection is already a problem for the CANDU-6 reactor where the lattice pitch is about 29 cm. The compact design of the ACR-700 core means that the feeder pipes are about 6 cm closer together than in a CANDU-6, making the ACR-700 center-core feeders even more inaccessible to inspection. The compact core of the ACR-700 also means that the reactor face radiation field will be higher than the equivalent CANDU-6 field, placing even more constraints on feeder pipe inspections of an ACR-700.

The Annulus Gas System

An annulus gas system (AGS) is a standard feature of all CANDU reactors, including the ACR-700, and is used to provide early warning of D_2O leakage from the heat transport system. The capability of detecting incipient D_2O leaks in an AGS is mandated by the CNSC in support of the "leak-before-break" strategy of dealing with pressure tube failures during reactor operation.

N_2 was initially used to fill the AGS but was replaced with CO_2 in the 1990s to limit troublesome C-14 production from the large cross section N-14(n,p)C-14 nuclear reaction. Nevertheless, CO_2 has proved to be less than ideal as an annulus gas because of chemical interactions with other species that are invariably present in the AGS. Deuterium gas permeates into the AGS through the stainless steel end fittings and reacts with CO_2 to form CO and D_2O. Thus the water vapor pressure in the AGS increases over time and gradually reduces the sensitivity of the dewpoint meters used for heat transport water leak detection. In addition, CO_2 under radiolysis undergoes complex reactions with the D_2, N_2 and CO invariably present in an AGS to form polymeric deposits that restrict gas flows and further compromise D_2O leak detection.

O_2 additions to the AGS have been implemented at currently operating CANDUs to oxidize D_2, N_2 and CO to non-deposit-forming species, but the associated production of ozone and nitrogen oxides raises the probability of enhanced corrosion of AGS components such as radiation shielding sleeves and bearing journals. Thus the AGS continues to be one of the more problematic systems in a CANDU reactor; problems that will, no doubt, be inherited by the ACR-700.

Discussion

In the material presented above I have considered AECL's "next generation" or "advanced" CANDU reactor design and shown it to be little more than a list of partial solutions to some well known problems with first generation CANDU reactors. It would obviously have been preferable for AECL to completely eliminate the source of each of these problems and produce a simplified, yet truly advanced, reactor design. However, because a D_2O moderator, a zirconium pressure tube and a CO_2 gas annulus are essential to the CANDU reactor design, it is all but impossible to remove these systems without compromising the functionality of the reactor. It is therefore inevitable that AECL's "advanced" CANDU looks a lot like a first generation CANDU in a new suit. In short, the ACR-700 is a CANDU-6 with some new plumbing and high performance fuel.

This being said, the few design changes that are incorporated in the ACR-700 design should offer at least *some* improvement in reactor performance compared to Canada's first generation CANDUs. It might then be argued that the ACR-700 is still worth building, especially in light of Ontario's burgeoning electrical energy crisis. However, before proceeding with the construction of even one ACR-700 Unit in Ontario, our energy planners need to be convinced of AECL's ability to deliver a working power reactor, incorporating new design elements, *on time and within budget*. Unfortunately AECL's recent performance in this regard has been less than reassuring, as the on-going saga of the Maple X reactor illustrates.

In 1996 AECL signed an agreement with MDS Nordion to build two Maple X isotope production reactors at Chalk River for $140 million. The reactors were slated for completion by May 2000 (Maple 1), and November 2001 (Maple 2). The first Maple did indeed go critical on schedule but over the ensuing 3 years the newly commissioned reactor experienced serious problems with shut-off rods and a positive, rather than the predicted negative, reactor power coefficient. By January 2002, the CNSC was so concerned with the performance of Maple 1 that it temporarily withdrew the reactor's low-power commissioning license. At the time of writing the Maple project is more than $160 million over budget, five years behind schedule and AECL are facing a multi-million dollar lawsuit from MDS Nordion that may take years to be resolved.

I believe AECL's predicament with regard to the Maple X reactor stems from the fact that, in spite of a 50-year legacy of building nuclear reactors, this once great engineering company has lost most of its expertise in reactor design. Many of the CANDU reactors operating in Ontario today were designed in the 1960s; other, newer, reactors commissioned in Ontario in the 1980s or early 1990s, were essentially old AECL designs modified by OPG's Design and Development Division. Hence, AECL engineers have done very little reactor design since the 1980s, and what has been done was mainly *the design of add-on systems or re-design modifications of existing systems* for aging CANDUs. Thus it is hardly surprising that AECL are struggling with the design of a new 10 MW isotope production reactor, never mind a 700 MW power reactor. And AECL can no longer turn to OPG for help in designing new reactors because OPG also lost its expertise in this area when it disbanded its own Nuclear Design and Development Division back in the 1990s.

Conclusions

In this letter I have presented evidence to show why it would be unwise for our energy planners to look to AECL for the provision of any type of power reactor system for construction in Ontario in the near future. This being the case, it is appropriate to ask if there is *any* future for nuclear power in Ontario? The answer to this question depends on what nuclear technology is used and who runs it. Ron Osborne, former President and CEO of OPG, addressed this issue when he said these words to employees at an OPG nuclear research facility in Toronto on May 9th 2000:

"If you look at nuclear operations in Ontario today, the evidence is crystal clear: we may have been the leader of the pack on the nuclear front back in the 70s but by the end of the 80s we had clearly lost that position. And as we sit here today we are holding up the back of the pack in terms of nuclear excellence.....

And I am a firm believer that we will run our nuclear plants better in this province when we bring in some new management. There is no other nuclear management in Canada. We have to bring in skill sets from outside. So it's inevitable that some new management is going to come from outside this country.... We need that help."

I believe that Mr. Osborne's words, in a slightly modified form, could also be applied to the design and construction of new nuclear facilities for Ontario:

"It's inevitable that some new nuclear reactors are going to come from outside this country.... We need that help."

Sincerely,

F. R. Greening

Dr. F. R. Greening

c.c Mr. Dwight Duncan
Minister
Ministry of Energy
Hearst Block, 4th Floor
900 Bay St.
Toronto ON M7A 2E1

Ontario Power Authority

175 Bloor Street East
North Tower, Suite 606
Toronto, Ontario M4W 3R8
T 416-967-7474
F 416-967-1947
www.powerauthority.on.ca

Rec'd: SEP 09 2005

09-08

September 6, 2005

Dr. F.R. Greening
12 Uplands Avenue
Hamilton, Ontario
L8S 3X7

Dear Dr. Greening:

Thank you for your August 28, 2005 letter detailing your view that there should be no new investment in CANDU-based generation. The initial work to which you refer and for which we are presently seeking input relates to the Supply Mix. As such, and with respect to nuclear, this work will not be getting into the details of what nuclear technology might be used. However, we will keep your letter on file for later stages of the planning process which become active in the early part of 2006.

Yours truly,

Jan Carr, C.E.O.
Ontario Power Authority

cc: The Honourable Minister Dwight Duncan, Ontario Ministry of Energy

bcc - A. Shalaby

A Submission to the Ontario Power Authority (OPA)

Concerning the

Selection of New Electricity Generation Capacity for

Ontario

By F. R. Greening Ph. D.

Introduction

I am a retired nuclear scientist with 23 years experience working for OPG's Research Division in Toronto. I have spent most of my professional career dealing with technical problems with OPG's fleet of CANDU reactors at Pickering, Bruce and Darlington. I am writing to the OPA to urge our electricity supply planners *not* to recommend the refurbishment or construction of any more CANDU reactors to supplement or replace the Province's existing electrical generating capacity. I base this view largely on the poor performance of certain critical systems inherent to the CANDU reactor design

The innovative features of the CANDU design, namely the use of D_2O as coolant and moderator, natural uranium fuel and the capability to refuel the reactor while operating under power, are implemented through systems involving great engineering complexity. For example, a Pickering 'A' reactor has over 2 km of specialized zirconium pressure tubing and over 7 km of feeder piping. Each reactor has 1,560 water and gas connections to the reactor core. Every one of these 1,560 connections has to be leak tight. If D_2O leaks from the reactor core it must be recovered and upgraded because it is very expensive to manufacture and contains radioactive tritium as a hazardous contaminant.

These features of the CANDU reactor design - that is the need for hundreds of fuel channels, end fittings, feeder pipes, annulus gas supply and return lines; as well as elaborate D_2O recovery and tritium control systems - have proven to be the source of unreliability and poor performance of aging CANDU reactors, especially compared to reactors of similar age incorporating less complex designs operating around the world. Unfortunately, the most significant of CANDU's deficiencies are long-standing problems caused by technical (design) issues that remain largely unresolved to this day.

Over the past 35 years CANDU reactors have been subject to their fair share of the same problems that have commonly been encountered in other reactors designs such as the BWR and PWR. These common problems include fuel failures, activity transport and steam generator corrosion. However, the history of CANDU reactor operations shows that our homegrown system derives most of its unreliability and high costs from:

(i) The use of D_2O and the associated production of tritium
(ii) The use of pressure tubes, feeder pipes and annulus gas systems.

These systems and components, *which are completely absent from other reactor designs*, are considered in detail below.

D_2O and Tritium

A typical CANDU reactor requires about 450 tonnes of heavy water (D_2O), valued at about $250 million. Nearly all of the tritium present in a CANDU reactor is produced by neutron activation of D_2O and is chemically bound as tritiated heavy water, DTO. A typical OPG reactor produces about 1.5 million Curies of tritium per year. In spite of every effort to prevent it, heavy water and tritium leak from an operating CANDU reactor. Most of the heavy water that leaks, or is spilt from a CANDU heat transport or moderator system, is recovered. However, a significant amount of D_2O escapes from containment and enters the environment through the so-called contaminated stack. The Pickering "A", Pickering "B", Bruce "A", Bruce "B" and Darlington contaminated stacks each exhaust the equivalent of about 0.5 kg of D_2O vapor per hour. Because the effective specific activity of tritiated water released to the environment from a mature CANDU reactor is ≈ 1 Ci/kg, each of the five CANDU stacks noted above release an average of about 5,000 Curies of tritium per year.

Tritium emission control is accomplished by liquid collection systems and by water vapor recovery through containment air drying. The moderator vapor recovery enclosure is the most important primary barrier for tritium control and the drying requirements for this enclosure are the most stringent of any in the station. Moderator room dewpoints are typically specified to be –40° C or lower at D_2O collection rates of up to 1 kg/hr. In most cases several 6800 m^3/hr capacity single-bed dryer units are used at OPG stations with 13X or 4A molecular sieve as the desiccant.

Areas such as moderator purification rooms and heavy water management areas in service buildings used for drumming operations involving high isotopic moderator D_2O also require effective vapor recovery dryers, as well as proper ventilation to reduce occupational dose. The reactor building itself offers a secondary, and final, barrier to tritium emissions to the environment. Reactor building air is passed through an exhaust dryer typically operated at an outlet dewpoint of –18° C thereby setting an upper control limit to the heavy water vapor losses through the contaminated stack.

The need to maintain and monitor expensive and labor intensive systems related to heavy water management and tritium emission control add substantially to the cost of operating a CANDU reactor.

Pressure Tubes

Pressure tube problems have plagued CANDU reactors since the early days of Pickering NGS in the mid 1970s. OPG, NBP, AECL and other members of COG, the CANDU Owners Group, have collectively spent over $100 million on pressure tube research and development in the past 20 years but achieved only marginal improvements in pressure tube performance. There have been problems with leakage at the pressure tube rolled joints, neutron induced creep of in-core pressure tube sections (leading to sagging), pressure tube embrittlement and hydride blister formation caused by excessive hydrogen pickup, and localized fretting corrosion.

Starting in 1974 many individual pressure tubes were replaced in Pickering and Bruce Units, typically involving outages of several months and a dose commitment of about 10 man-rem per tube. In August 1983 pressure tube G16 in Pickering Unit 2 suffered a catastrophic rupture and the decision was made to replace all 390 pressure tubes in all four Pickering "A" Units.

One would expect that after OPG and AECL fixed all these early problems, CANDU pressure tubes would now be able to deliver many years of trouble free service. Indeed, the CNSC stipulates that nuclear pressure boundary materials meet stringent inspection codes as a licensing requirement. Unfortunately, the complexity and inconsistent results of pressure tube inspections over the past 25 years leave the question of future CANDU pressure tube performance still very much in doubt. For example, in the CNSC's 2004 *Reason for Decision* on Bruce 'A' there is a section, albeit a very short one, that discusses the issue of pressure tube integrity. The perfunctory discussion offered by the CNSC fails to deal with, or even mention, some very important observations concerning Bruce 'A' pressure tubes. Just a small sampling of these observations is given below:

- Anomalous eddy current (EC) scans for a number of Unit 4 pressure tubes during SLAR inspections carried out in 1993.

- Some EC scans near the center of channel B4O13 that were so noisy it was impossible to reliably locate the spacers. The noisy EC signal was attributed to *either* very thick oxides *or* magnetite deposits.

- SLAR UT blister detection inspections, also carried out in 1994, produced highly variable signals that were later shown to be caused by interferences from lubricant and/or adhesive contaminants.

- Metallographic sectioning of removed tubes carried out in 1993 - '94 showed *some* very thick patches of oxide on ID surfaces close to mid-bundle positions. Other sections that were predicted to have thick patchy oxides on the basis of EC inspections, were found to have thin uniform oxides.

- Data on deuterium uptake by Bruce pressure tubes are largely derived from scrape samples taken from "scrape campaigns" first undertaken on Unit 3 in October 1988. By 1993 it was realized that all previous scrape data were essentially worthless because of oxide contamination of the samples.

- Scrapes taken from pressure tube outlet regions of Unit 3 in 1994 were higher than predicted by the current AECL/OPG deuterium uptake model. The model was therefore revised to accommodate the new data.

- Re-scraping of Bruce 3 tubes in 1996 showed a *decline* in deuterium levels. AECL/OPG declared that the 1994 data were obviously in error and should not be included in deuterium uptake prediction calculations.

These observations raise serious concerns about the reliability of the inspection procedures used for pressure tubes at Bruce, and undermine any belief in the long-term integrity of pressure tubes in all CANDU reactors. Certainly, as a veteran of many years of research into pressure tube corrosion and hydrogen pickup, I can attest to the poor level of mechanistic understanding of pressure tube behavior inside a CANDU fuel channel in spite of the efforts of literally hundreds of scientists and engineers worldwide.

A good example of an observation lacking a cogent explanation is the remarkable variability, frequently by more than a factor of two, in the rate of corrosion and deuterium uptake by nominally identical pressure tubes sitting side by side in a reactor. The through-wall distribution of deuterium is another mystery. Some researchers have observed a deuterium concentration peak just below the oxide-metal interface in laboratory specimens of Zr-2.5%Nb. This would give *elevated* deuterium values compared to the bulk average value sought by scrape measurements. However, other studies indicate a possible *depleted* zone in the near-surface region of a pressure tube caused by migration of deuterium away from the oxide-metal interface during reactor cooling. In this case, all scrape data currently accepted by the CNSC are biased low.

The CANDU research community is also unable to account for another unexpected problem observed in a number of Bruce "A' fuel channels: namely, thick oxide patches in high flux regions of the core. Unfortunately, the true extent of this problem is largely unknown and this ignorance is compounded by the phenomenon of oxide spalling, which is known to have occurred in Bruce 'A' Units. Measurements on heat transport system particulate from Bruce Unit 3 indicate that several *kilograms* of pressure tube oxide have been released to the coolant over 15 years of operation.

An additional observation that should give added cause for concern to the operators and regulators of CANDU reactors is the detection of lithium-6 enrichment and beryllium braze bearing-pad corrosion product in oxide patches formed in high-flux areas of some tubes removed from Bruce reactors.

Feeder Pipes

Feeder pipe cracking and wall thinning was first discovered in CANDU reactors in the 600 MW(e) Unit at Point Lepreau in 1997. Subsequent studies have shown that wall thinning is widespread in CANDU outlet feeders and has become a very serious issue for OPG's aging fleet of reactors. The wall thinning observed in CANDU reactors has been attributed to flow accelerated corrosion (FAC). Studies have show that FAC is most likely to occur at tight bends in carbon steel piping carrying high temperature water at high flow velocities; a condition present at the first elbow of every outlet feeder pipe in CANDU reactors. FAC in Pickering "A" Units has been very severe for a number of reasons, but in particular:

(i) The use of carbon steel containing less than optimum chromium.
(ii) The use of aggressive decontamination reagents in the mid 1980's

FAC is a very complex phenomenon that is poorly understood in spite of considerable research by AECL and OPG. Some important facts to consider are:

- The initial wall thickness of feeder pipes varies between 7 mm and 3.5 mm.

- 40 % of the original wall thickness is the maximum acceptable thinning.

- The wall thickness at a feeder pipe bend is subject to considerable variability making it difficult to determine feeder thinning *rates* at this critical location without a number of repeat measurements.

- Up to February 2005, ultrasonic measurements at the extrados of the first elbow of Pickering 'A' feeders found a minimum wall thickness greater than 3 mm. At this time the extrados of the first elbow was considered to be the location most susceptible to wall thinning and it was therefore concluded that the Pickering feeders were within the fitness-for-service guideline.

- In April 2005 *direct* micrometer measurements were made at the extrados *and intrados* of two removed feeders from P1. These measurements gave the unexpected result that *the elbow intrados was thinner than the associated extrados, and well below the fitness-for-service guideline*.

To conduct a full outlet feeder inspection on a large CANDU reactor costs about $10 million and involves a radiation dose to the inspection crew of about 27 man-rem. To remove and replace *one* feeder pipe from a CANDU reactor costs about $1 million. To remove and replace the full complement of feeders in a Pickering 'A' Unit (390 pipes in total), costs about $300 million. Worse yet, a full feeder pipe replacement would take at least a year to complete and allow millions of dollars of interest charges and replacement fuel (coal?) costs to accrue on the refurbishment debt.

The Annulus Gas System

The annulus gas system is a specialized gas circulating system unique to the CANDU reactor design. It is used to provide thermal insulation between the high temperature heat transport system and the moderator, which must be kept cool for efficient reactor operation. CANDU reactor operators also rely on the measurement of water vapor in the annulus gas system (AGS) for the detection of small pressure tube leaks. Nitrogen gas was originally used in CANDU annulus gas systems but was found to produce Curie quantities of carbon-14 in gaseous and solid forms. After the completion of the Pickering Large Scale Fuel Channel Replacement (LSFCR) project in the early 1990's, all domestic CANDU Units switched from N_2 to CO_2-filled annulus gas systems. This switch created a new set of problems due to the unexpected formation of radiolytically-produced intractable polymeric deposits that plugged the annulus gas lines and flow rotameters. More recently, batch additions of O_2 have been made to the AGS of operating CANDU Units in an attempt to prevent annulus gas system plugging.

In 1991, as part of the re-commissioning of Pickering 'A', it was deemed necessary to test the pressure tube leak detection capability of a refurbished Unit to verify that the AGS exhibited the predicted response to a controlled injection of moisture. A series of leak detection tests was therefore carried out on Pickering Unit 3 (P3). A typical test involved the injection of D_2O into

the external AGS circuit to simulate a pressure tube leak in the range of 20 g/hour. Previous tests of this type had been successfully carried out on a newly commissioned Darlington Unit in the late 1980's. It therefore came as a complete surprise when the P3 AGS response to moisture injection fell well below expectations. After 5 hours of continuous D_2O injection, a dew-point meter response equivalent to only 25 % of the expected water vapor concentration was measured.

Additional tests of the P3 AGS response to helium injections suggested that the injected water vapor was being held up within the AGS pipe-work by some type of adsorption phenomenon. Confirmation of this hypothesis was provided by subsequent tests of the purge dry-down response of the P3 AGS. Sluggish system response was observed and attributed to the slow *de-sorption* of water from sites that had previously adsorbed water vapor from the moisture laden gas stream.

It is now believed that the sluggish response of the P3 AGS during the July 1991 moisture injection tests was caused by corrosion product that had become dispersed throughout the pipe work of this system since the early 1970's. The source of the P3 AGS corrosion product is the carbon steel shielding sleeves and bearing journals located between the stainless steel lattice tubes and end fittings in each fuel channel. It is well documented that in the period 1973 -'75 the P3 AGS was subject to significant D_2O in-leakage and concerns over delayed hydride cracking lead to the replacement of 17 pressure tubes in 1975. Station records show that the D_2O in-leakage problem in P3 was so severe that the entire AGS was flooded a number of times and the carbon steel components in many lattice tubes were subjected to long periods of severe corrosive attack. Regrettably, this unanticipated corrosion has generated substantial quantities of poorly adherent hydrated iron oxide (rust) in the affected fuel channels.

Because of the inaccessibility of much of the pipe work, the full extent of the cumulative corrosion damage to the P3 AGS remains uncertain. However, it is probable that, by the time of the start of the P3 LSFCR in the fall of 1989, kilogram quantities of non-adherent rust particulate had accumulated in the P3 AGS. Furthermore, it has been reported that: "*vacuuming the material was not very successful*". Thus, even *after* the P3 reactor was returned to service in the fall of 1991, the majority of the pre-LSFCR corrosion debris remained in the AGS. It is also quite probable that other CANDU reactors besides Pickering Unit 3 have annulus gas systems with restricted flow from corrosion deposit and/or radiolytic polymer formation. Oxygen addition *may* inhibit polymer formation, but recent research has implicated nitrogen from air ingress as a new and troublesome polymer precursor.

Discussion

As noted previously, the CANDU reactor design incorporates a number of intricately engineered and highly complex systems that require an inordinate amount of skilled manpower to operate, inspect and repair. Many components are difficult to access, or are located in areas of high radiation fields, adding to the problems of CANDU reactor operation and maintenance. This situation is reflected in the exorbitant OM&A costs routinely reported for domestic CANDU

reactors which, as we shall show, are largely attributable to the high staffing levels required to safely operate CANDU reactors.

To quantify CANDU operating costs we quote from OPG's latest financial results that cover the period for the first half of 2005. For its nuclear operations, OPG report $1,120 million in revenues from the sale of 21.4 TWh of electricity. OPG's OM&A costs for this electricity are stated to be $859 million, equivalent to $40/MWh, *or 79.5 % of revenues*.

It might be argued that OPG, as a government enterprise, is notoriously inefficient in how it runs its business. However, a comparison of OPG's nuclear operations to Bruce Power's privately run, for profit, nuclear operations shows otherwise. Thus Bruce Power's operating expenses, excluding fuel, for the six months ended June 30, 2005 were $39/MWh, or only marginally below OPG's $40/MWh for the same time period.

And to support the claim that the staffing levels at CANDU stations are excessive in comparison to other non-nuclear stations, we present some representative data for the number of employees at some well-known power stations in Canada.
(N.B. Nanticoke and Lambton are coal-fired, Darlington, etc, are nuclear):

Facility	**Available Capacity(MW)**	**Number of Employees**	**Employees/ MW**
Nanticoke	3938	600	0.15
Lambton	1975	300	0.15
Darlington	3524	3000	0.85
Bruce A & B	4680	3700	0.79
Pickering A & B	3090	5400	1.75
Point Lepreau	600	530	0.88

As a further comparison, it should be noted that the average staffing level for U.S. nuclear power plants is about 0.5 employees/MW, *or about half the number required to run a typical CANDU plant*.

Fuel costs per MW of electricity generated are, of course, much lower for CANDU than for any conceivable fossil fuelled station - a fact much emphasized by proponents of nuclear power. However, when capital costs are added to fuel *and OM&A costs*, CANDU-generated electricity must be priced at about $75/MWh just to break even. Thus, far from being "too cheap to meter", CANDU power is at least 25 % more expensive than any fossil fuelled electricity currently available in Ontario.

Summary and Conclusions

When the CANDU reactor was first introduced in the 1960s, particularly in the demonstration Units at Rolphton and Douglas Point, it was proclaimed by AECL to be a reliable and economic means of producing electricity. Eight larger and even more ambitious versions of the basic CANDU design soon followed at the Pickering and Bruce sites. Initial performance of these Units was promising. Indeed, some early CANDU Units led the world in annual average capacity factor, an accepted measure of reactor reliability.

Unfortunately, as Ontario's CANDU reactors approached 20 years of operation, serious problems with critical components started to emerge. Pressure tube integrity became a major issue in the 1980s, while steam generator corrosion and annulus gas problems dominated the 1990s. Outlet feeder pipes are the latest CANDU components to suffer from premature failures. Thus, looking at the status of CANDU in the year 2005, we see many of the 22 domestic Units in need of major refurbishments or already abandoned as beyond repair. This situation has arisen within 30 years of the commissioning of most of these Units; worse yet, some Units were shut down for long periods during their lifetime.

The hard pill for AECL to swallow is that CANDU's innovative engineering, seen as leading edge in the 1960s, has become its Achilles' heel by the year 2000. This is perhaps not so surprising for 50 year-old technology. After all, many engineering marvels from the 1960s, such as the Space Shuttle and Concorde, have now outlived their usefulness as recent events have so dramatically shown. But, to return to the main thesis of this submission, CANDU was destined to run into difficulties due to the complexity of its design. Corrosion is a well-known concern for all nuclear plant, but when it occurs in essentially inaccessible pipe work, such as the annulus gas system, it presents a problem that is next to impossible to fix.

As we have shown, each new problem that developed in CANDU reactors - whether it was leaking pressure tube rolled joints, annulus gas system flow blockages or feeder pipe thinning – has required more inspections leading to more outages and higher OM&A costs. The CANDU reactor was always an experimental venture; it has had its successes and was probably a worthwhile undertaking because it added to our understanding of nuclear science and engineering. However, it is time to declare the CANDU experiment over, and move on to something simpler, something proven, something better.

F. R. Greening
Hamilton, Ont
August, 2005

To:

Mr. Jan Carr
Chief Executive Officer
Ontario Power Authority
175 Bloor Street East
North Tower, Suite 606

From:

Dr. F.R. Greening
12 Uplands Ave.
Hamilton
Ontario
L8S 3X7

Toronto, Ontario
M4W 3R8

Tel: 905-317-4544
Greening@sympatico.ca

August 28, 2005

Dear Mr. Carr,

It is my understanding that the Ontario Ministry of Energy has issued a directive to the Ontario Power Authority to develop an integrated plan to ensure a reliable long-term electricity supply for Ontario. To this end, I believe the OPA will be seeking input on supply options from the general public during the period September to December of this year.

Based on recent statements from Energy Minister Dwight Duncan, new nuclear generation capacity is being considered as a major component of Ontario's future electricity supply, and various "improved" CANDU reactor designs are already being actively promoted by AECL.

I am writing as a former OPG research scientist, with 23 years experience in nuclear operations, to suggest that any further investment in generating capacity based on the CANDU design would be a serious mistake. I have put together a summary of my reasons for rejecting CANDU technology in an attachment to this letter and would ask that this material be considered by the OPA.

Sincerely,

Dr. F. R. Greening

c.c Mr. Dwight Duncan
Minister
Ministry of Energy
Hearst Block, 4th Floor
900 Bay St.
Toronto ON M7A 2E1

Hon. Dwight Duncan
Ontario Minister of Energy
900 Bay Street
4th Floor
Hearst Block
Toronto, ON
M7A 2E1

July 13, 2005

Dear Minister Duncan:

Re: Building a sustainable, safe, reliable and clean energy future for Ontario

We the undersigned write to you as a new and growing network of public interest organizations seeking to promote and advocate a safe and sustainable energy future for Ontario.

We were very much encouraged by your stated intention to create "…a clean, reliable, diverse and sustainable supply of energy" for the province. We believe that we have common cause with you and your government, but believe Ontario must ask itself the fundamental question – how do we build such a sustainable, safe, reliable, clean energy future for Ontario? You have demonstrated your commitment by phasing out Ontario's dirty coal-fired generation stations. We laud you for this initiative.

We were also encouraged by your May 5th Empire Club speech, in which you noted that "[t]he first 40 years in Ontario's nuclear experiment has had significant cost over-runs, inefficiencies and breakdowns that we cannot and should not ignore." These are the mistakes of the past that we hope Ontario will avoid repeating. This is why we have severe reservations about the role of nuclear power in Ontario's future supply mix.

Our concerns include:

- Nuclear power's prohibitive cost;
- poor reliability and performance;
- enormous security risks, such as terrorist attacks;
- risk of a catastrophic accident;
- the routine and accidental emissions of radioactive substances from Ontario's reactors;
- the environmental legacy of uranium mining; and,
- the problem of how to safely manage radioactive wastes for up to a million years.

In this light, we have serious concerns about your restart of reactors at the Pickering A nuclear station, and your government's potential imminent decision to offer Bruce Power a deal with advantages not given to other forms of power generation, extending the life of Ontario's oldest reactors and perpetuating the societal risks of nuclear power.

Instead, we believe that Ontario's energy policy decisions must henceforth be made to put us on the path to a sustainable energy future - ambitiously developing low impact renewable energy as well as conservation and efficiency. For example, you have an opportunity to make a decision right now to support community power through standard offer contracts.

Other jurisdictions have been successful in putting themselves on the path to a cleaner more sustainable energy future. Germany installs more wind power annually then your government's current target for all renewable energy sources. And last week even our neighbour Quebec committed to doubling its target for wind power. Ontario's potential is even greater.

We would like to request an opportunity to meet you as a group sometime in August to discuss our common goal of building a greener more sustainable energy system for Ontario. In particular, we would like to present to you our energy vision for the province.

We would also like to request clarification regarding your newly created authority to issue supply directives. We have attached several questions and would appreciate response from your office as soon as possible.

Again, we look forward to meeting and discussing how we can collaborate on moving toward our common goal of developing a clean, reliable, diverse sustainable energy supply for Ontario.

Ecologically yours,

Canadian Environmental Law Association
Ontario Sustainable Energy Association
Greenpeace Canada
Sierra Club of Canada
Sierra Club of Canada – Ontario Chapter
Women's Healthy Environments Network
International Institute of Concern for Public Health
Provincial Council of Women of Ontario
Ontario Voice of Women
Ottawa-Vanier Green Party
Canadian Association of Physicians for the Environment
Citizens' Environment Alliance of Southwestern Ontario

For communication purposes, **please contact:**

Shawn-Patrick Stensil, Energy Campaigner Greenpeace Canada,
416-597-8408 ex 3013. Fax: 416-597-8422.
Suite 605,
250 Dundas St. W.,
Toronto, Ontario, Canada, M5T 2Z5

Attachment – Questions for Clarification

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GREENPEACE

August 26, 2005

250 Dundas St. W., Suite 605
Toronto, Ontario M5T 2Z5
tel: 416-597-8408 X 3050
E-mail: dave.martin@yto.greenpeace.org

Mr. Jan Carr
CEO, Ontario Power Authority
Members of the Board, OPA
175 Bloor St. E., North Tower, Suite 606
Toronto, Ontario M4W 3R8
By Fax: 416-967-1947
By E-mail: supplymixsubmissions@powerauthority.on.ca

Re: Power to Change - A Submission from Greenpeace Canada to the Ontario Power Authority

Dear Mr. Carr and Members of the Board of Directors,

Please find below a submission from Greenpeace Canada on the "Supply-Mix" consultation initiated in July.

Greenpeace Canada is a non-profit organization that uses lobbying, science, public education, market mobilization and non-violent direct action to protect the natural environment. Founded in Canada in 1971, Greenpeace is now the world's largest environmental organization with more than 2.8 million supporters worldwide, including 69.000 in Canada.

Greenpeace has had a longstanding interest in Ontario's electricity system and in 2004 commented on Bill 100, the Electricity Restructuring Act. Greenpeace is also regular intervenor at the Ontario Energy Board as part of the Green Energy Coalition, whose other members include the Energy Action Council, the Sierra Club of Canada and David Suzuki Foundation.

We wish to endorse the submissions of the David Suzuki Foundation, as well as that of the Canadian Environmental Law Association and the Pembina Institute. However, we also wish to make some additional comments.

While recognizing that cost and price inevitably play important roles, Greenpeace is primarily concerned about the environmental impacts of the electrical system. The OPA will likely make recommendations on the boundaries for development of various technologies, and in the process, may address fundamental issues of system structure, including the role of government and utilities versus market-driven and competitive processes. In our view, the real challenge is to change electricity technologies, and the system structure is secondary. Public or private, we believe that both coal and nuclear generation should be phased out and replaced by a combination of conservation and efficiency measures, renewable energy, and Combined Heat and Power (CHP) and industrial cogeneration projects.

We have made comments below on Conservation, Renewable Energy, Nuclear Power, and the OPA Consultation Process.

Conservation

In his instruction letter of May 2, 2005, Ontario Energy Minister Dwight Duncan asked the Ontario Power Authority (OPA) to make "recommendations with respect to conservation targets for Ontario for 2015, 2020 nd 2025, taking into account the target already set by the Government of Ontario for 2007".

In their May 2004 report, *Power for the Future: Towards a Sustainable Electricity System for Ontario,* the Canadian Environmental Law Association and the Pembina Institute found that electricity demand in Ontario could be reduced by almost 50% by 2020. The study suggested that this significant level of demand reduction could be achieved through three types of technological and behavioural changes: (a) adoption of energy-efficient technologies, (b) expansion of Combined Heat and Power (CHP or cogeneration) in the industrial, commercial and institutional sectors, and (c) fuel switching from electricity to natural gas for space and water heating in residential, commercial and institutional sectors. More detailed programmatic suggestions were made in the report. The government has failed to act on the creation of System Benefits Charge that could fund conservation efforts in the province.

To date in its mandate, the government has failed make *any* significant progress on conservation. Without a dramatic shift in attitude, there seems little hope that the government will be able to meet its minimal political promise to reduce electricity demand 1350 MW (5%) by 2007 and 2700 MW (10%) by 2010. These targets and more can be achieved. The government's targets should be at least doubled.

Renewable Energy

In his instruction letter of May 2, 2005, Ontario Energy Minister Dwight Duncan asked the OPA to make "recommendations with respect to additions of new renewable energy capacity by 2015, 2020 and 2025, taking into account the targets already set by the government of Ontario for 2007 and 2010".

The *Power for the Future* report suggested that new renewable energy could provide 30% of supply by 2020. That report has been faulted for making too low an estimate of renewable energy potential. For example, in its report *Smart Generation*, the Suzuki Foundation has suggested that Ontario could install 8,000 MW of wind capacity alone by 2012. The average cost of renewable energy at under 8 cents/kWh for the government's first 300 MW Request for Proposals indicates that renewable energy is competitive with natural gas, and is cheaper than nuclear power.

This would require a much more aggressive approach, including the implementation of a system based on Standard Offer Contracts for renewable energy. We were thus encouraged by the Minister's statement that he intends to proceed with such a system (Tyler Hamilton, "Ontario to open floodgates to clean power", *Toronto Star*, August 22, 2005, p. C1). We would encourage the inclusion of solar hot water and photo-voltaic systems in this process. In order to be successful, this process must be adequately priced, and should be open-ended in order to *truly* open the floodgates of renewable energy.

Nuclear Energy

The Greenpeace position presented to the government one year ago in August 2004 has proven prophetic. At that time we suggested that the refurbishment of the Pickering A nuclear station was dangerous and overly expensive. In its August 12 decision to permanently shut down reactors 2 and 3, Ontario Power Generation acknowledged that the cost and risk of refurbishment would have been too great.

The reconstruction of the Pickering A reactors was originally approved on basis of an August 1997 estimate of $780 million to re-start all four reactors. OPG has already spent $2.6 billion re-starting just reactors 4 and 1 -- and reactor #1 has not yet entered into commercial operation.

As the OPA consults with the public during the hot smoggy summer of 2005, the government continues to conduct clandestine negotiations with Bruce Power for the restart of two more reactors (units 1 and 2) at the Bruce "A" nuclear station. These problem-plagued reactors have been shut down respectively since 1997 and 1995. In 2001, the former Conservative government signed an 18-year sweetheart deal with Bruce Power which gave the private company a guaranteed market, and relieved them of responsibility for the long-term liabilities of radioactive waste management and reactor decommissioning -- public subsidies for private profit. A similar give-away deal is being considered for the restart of Bruce "A" reactors 1 and 2. Like Pickering A reactors 4 and 1, if it proceeds, the Bruce deal will raise both electricity rates and safety concerns as pressure mounts to cut corners and get these old dangerous reactors up and operating.

Moreover, Premier McGuinty recently stated that "we are not ruling out new nuclear [plants]", and Energy Minister Dwight Duncan stated "Clearly we have to look seriously at nuclear." (Richard Brennan, "Nuclear plants needed: Duncan", *Toronto Star*, August 20, 2005, p. 1). These statements raise doubts about the integrity of the current consultation process, if indeed, as it seems, the government has already made up its mind to proceed with new nuclear power plants in Ontario. This would be the first new nuclear construction in Ontario since the Darlington nuclear station was ordered in 1973 by the then Conservative government of Bill Davis.

There are numerous problems with nuclear power:

- Nuclear power is unreliable and performs very poorly. Eight out of twenty reactors had to be shut down in 1997 because of poor performance and safety problems. Only four of the eight have been restarted.

- Nuclear plants provide baseload generation but require coal plants to meet daily and seasonal peaks in demand. Nuclear and coal are partners in a dirty electricity tag team.

- Coal generation, with accompanying emissions of sulphur dioxide, nitrogen oxides and carbon dioxide, has increased dramatically as a result of poor nuclear performance. Ontario Hydro/Ontario Power Generation emissions of sulphur dioxide and nitrogen oxide more than doubled from 103.5 thousand tonnes in 1995 to 215.7 thousand tonnes in 2000.

- Nuclear power is not "clean". There are 30,000 tonnes of deadly radioactive waste piled up at OPG reactor sites in Ontario, and this waste is deadly for a million years. There are also routine and accidental emissions of cancer-causing pollutants such as tritium and Carbon-14 from all CANDU reactors.

- Nuclear power is dangerous. The Pickering "A" reactors lack a second emergency shutdown system that is required in every other nuclear plant in the western world. It is closer to more people than any other nuclear station in the world. A meltdown would devastate Canada's industrial heartland.

- Money spent on nuclear plants will prevent meaningful investment in green energy alternatives such as conservation, wind and solar.

The primary concerns of Greenpeace and Ontarians is with the adverse environmental impacts and safety problems of nuclear power. However, high cost is also a concern. With its decision to permanently shut down Pickering reactors 2 and 3, OPG itself has acknowledged that nuclear refurbishment is too expensive.

With regard to the cost of new nuclear plants, in 2003, Atomic Energy of Canada Limited (AECL) claimed that the Advanced CANDU Reactor (ACR - still being designed) would cost $12 billion for eight 700 MW reactors (5600 MW). It also claimed that eight 700 MW CANDU-6 reactors of the current design would cost $16 billion.

Ontario would be colossally foolish to be the guinea pig for an ACR reactor which has not been tested, built or even completely deigned as yet - prototype reactors are infamous for having technical problems. However, there have also been extremely serious problems with CANDU reactors built in Ontario.

The Darlington nuclear station is the most recent plant built in Canada. It has four 880 MW reactors and the final cost was $14.319 billion -- more than three and a half times the original release estimate of $4.070 billion in 1978. The last of the four reactors went into commercial operation in 1993.

To compare the cost of these alternatives...
- the hoped-for capital cost for 8 ACRs is $2143/kW
- the hoped-for capital cost for 8 CANDU-6s is $2857/kW
- the real capital cost of the Darlington nuclear plant was $4062/kW

To put this in perspective, a 2001 report put capital costs for nuclear plants in a range from about $1750/kW (USD) to $2000/kW (USD). It has been widely accepted that in order to be competitive with coal and natural gas, this has to be reduced to $1000/kW (USD) (currently about $1200 CAD). In 2001, AECL claimed that the capital cost for a CANDU 6 was about $1850/kW (USD) (currently about $2200 CAD), and that this cost had to be reduced 46% (i.e. to $1012 CAD) to be competitive (*AECL Corporate Plan Summary 2001-02 to 2005-06*, November 28, 2001, p. 30).

In order to estimate total unit energy costs or lifetime unit energy costs, assumptions have to be made about the lifetime and the performance (measured in capacity factor) of the plants, which yields an estimated price per kilowatt-hour. The nuclear industry usually comes up with absurdly low costs, assuming fantastic performance (like 90% CpF) and long lifetimes (40 years). Traditionally, the assumption has been that nuclear power plants are expensive to build but cheap to operate (low fuel and operating costs). In fact, CANDU reactors not only have a high capital cost, but disastrously poor performance (some reactors under 50% CpF), and therefore high operating costs as well. They also have short lifetimes (25 years or less) before major refurbishment is required -- the worst of all worlds.

The OPA Consultation Process

Greenpeace has serious concerns about the validity of the OPA's consultation process to date. We must assume good faith in all consultation processes, but there are still strengths and weaknesses in any process that need to be examined closely.

(A) Consulting about consultation

Early in the planning process, the OPA should have met with members of the public to discuss the terms of reference, including: a precise definition of the initiative, range of alternatives being considered, possible outcomes, and their implementation. To the best of our knowledge, this did not happen. Certainly Greenpeace was not included consultation about the consultation.

(B) Willingness to incorporate input

In any consultation process the single most important issue is the willingness of the consulting body (the OPA) and the ultimate decision-maker (the Ontario Government) to address our input. If we cannot influence the outcome, the exercise is meaningless.

A moratorium on controversial activities would indicate good faith and a willingness to truly consider change. Just the opposite, however, has occurred. Prior to and during this process, the government has proceeded with several extremely controversial activities, namely the refurbishment of the Pickering reactor #1 and the announcement to the *Toronto Star* editorial board on Friday August 19, 2005 that the government intends to pursue construction of new nuclear plants.

Furthermore, the instructions from the Minister have asked the OPA to make recommendations for conservation and renewable energy targets "taking into account" the targets already set by the government for 2007. Greenpeace believes that the targets of 1350 MW (5%) demand reduction by 2007 and 2700 MW (10%) by 2010 are inadequate, and should be reconsidered. We ask the OPA: are you prepared to recommend that the government reconsider those targets? Similarly the targets for renewable energy of 1350 MW (5%) by 2007 and 2700 MW (10%) by 2010 are wholly inadequate. We ask that these targets also be reassessed and upgraded. Both should be at least doubled.

(C) Scope of the process

- We believe that environmental objectives need to be given at least equal consideration with economic objectives in long-term planning.
- A full range of sustainable energy alternatives need to be considered, including full ranges of alternative scenarios that do not include the use of either coal or nuclear power as base-load capacity
- The OPA's 2-page "Call for Written Submissions" is vague and general and does not provide an informative or adequate basis for a meaningful consultation
- There is no indication if the process will be flexible enough to incorporate new concerns and alternatives as they arise. For example, will public consultation continue in the future development of the OPA plan, after August 26th, leading up to the recommendation on December 1st? And will consultation continue as implementation proceeds after December 1, 2005? If so, what form will those consultations take?

(D) Is consultation with the OPA "real" consultation?

As the OPA's "Call for Written Submissions" notes, under the *Electricity Act* the Minister may issue directives (see section 25.30(2) of the Act) to the OPA. The OPA has been required to submit its "advice" on long term plans to the Minister. Greenpeace Canada and 12 other Ontario-based environmental NGOs have asked Minister Duncan to clarify his intentions as to whether he intends to issue supply and/or conservation directives, and if so when, and whether there will public consultation on them (see attached letter, July 13, 2005). At this time we have not received any response to our letter or request for a meeting. At issue is the question of whether a consultation process with OPA is truly meaningful, when legislatively, real power seems to lie with the Minister if he chooses to use it. Will we ever be asked to have a consultation process with the real decision-makers?

(E) Poor timing and inadequate notice

Mid-summer is a time when most Ontarians take holidays. Although the Minister issued his letter of instruction to the Chief Executive Officer and members of the Board of OPA on May 2, 2005, the OPA did not issue public notice of the consultation process until the end of the first week of July. The public has not been adequately notified. Seven weeks is a totally inadequate amount of time to offer meaningful input. The mid-summer timing of this process and its inadequate length does not allow for meaningful consultation.

We note that the OPA Vice President Paul Bradley initiated a similarly short, three-week summer-time consultation on power procurement between July 8 and 29. These abbreviated, poorly timed consultations might lead a cynic to think that the OPA is trying to discourage, rather than encourage public input.

(F) Disclosure and Access to Information

The public should have access to all relevant information:

- All submissions in this process should be posted on the OPA website.
- All reports of the OPA's consultants' on the supply-mix issue should also be posted -- uncensored, and in their entirety.
- OPA board minutes and all memoranda to and from the Board should be made public in a timely fashion.
- Minutes, reviews and input from government agencies should be made public.
- Speedy and full answers should be provided to public inquiries.
- Public briefings by OPA experts and consultants should have been held at the beginning and throughout the process. Why have there been no public meetings?
- The public should have full access to the OPA library, and lists of newly acquired material should be published regularly.

(G) Resources for participation

The general public and many public interest groups do not have adequate resources to compete with the government or corporate intervenors. The OPA should provide funding for:

- independent research;
- networking activities; as well as
- travel expenses, childcare, translation and miscellaneous expenses.

(H) Meeting design

Assuming that the OPA can be convinced that public meetings are a good idea...

- meetings should be open to the public and the media;
- secretarial assistance should be provided; and
- professional facilitation should be provided if needed.

(I) The Public Record

Documentation of public input is essential. Dissenting views should not be ignored or relegated to a "minority" report. The public should also have the opportunity to review and approve the record of our input. Consultation is also a two-way street, and the OPA should respond directly to the concerns raised by public interest intervenors.

Conclusion

A poll conducted by Greenpeace in May 2005 indicated overwhelming support for green energy -- 91% of Ontarians support increased use of solar and wind power and 92% support the increased use of energy conservation and efficiency programs. A majority (51%) think that nuclear power is dangerous, are concerned about radioactive waste and believe that it should be phased out.

If the people of Ontario are to have their voice heard, the OPA and the Ontario government need to initiate a better consultation process. Greenpeace and other environmental organizations have first-hand expertise in public consultation. It's time to consult us about consultation.

In Ontario, the will of the people coincides with environmental protection and good economics. Green energy is cleaner, safer, cheaper and more reliable than nuclear power. The OPA should support a sustainable electricity future for Ontario that includes the phaseout of both coal and nuclear power. That's why this submission was entitled "Power to Change".

Sincerely,
GREENPEACE CANADA

David H. Martin
Energy Coordinator

Enclosure
(July 13TH letter to Minister Duncan)

Hon. Dwight Duncan
Ontario Minister of Energy
900 Bay Street
4th Floor
Hearst Block
Toronto, ON
M7A 2E1

July 13, 2005

Dear Minister Duncan:

Re: Building a sustainable, safe, reliable and clean energy future for Ontario

We the undersigned write to you as a new and growing network of public interest organizations seeking to promote and advocate a safe and sustainable energy future for Ontario.

We were very much encouraged by your stated intention to create "...a clean, reliable, diverse and sustainable supply of energy" for the province. We believe that we have common cause with you and your government, but believe Ontario must ask itself the fundamental question – how do we build such a sustainable, safe, reliable, clean energy future for Ontario? You have demonstrated your commitment by phasing out Ontario's dirty coal-fired generation stations. We laud you for this initiative.

We were also encouraged by your May 5th Empire Club speech, in which you noted that "[t]he first 40 years in Ontario's nuclear experiment has had significant cost over-runs, inefficiencies and breakdowns that we cannot and should not ignore." These are the mistakes of the past that we hope Ontario will avoid repeating. This is why we have severe reservations about the role of nuclear power in Ontario's future supply mix.

Our concerns include:

- Nuclear power's prohibitive cost;
- poor reliability and performance;
- enormous security risks, such as terrorist attacks;
- risk of a catastrophic accident;
- the routine and accidental emissions of radioactive substances from Ontario's reactors;
- the environmental legacy of uranium mining; and,
- the problem of how to safely manage radioactive wastes for up to a million years.

In this light, we have serious concerns about your restart of reactors at the Pickering A nuclear station, and your government's potential imminent decision to offer Bruce Power a deal with advantages not given to other forms of power generation, extending the life of Ontario's oldest reactors and perpetuating the societal risks of nuclear power.

Instead, we believe that Ontario's energy policy decisions must henceforth be made to put us on the path to a sustainable energy future - ambitiously developing low impact renewable energy as well as conservation and efficiency. For example, you have an opportunity to make a decision right now to support community power through standard offer contracts.

Other jurisdictions have been successful in putting themselves on the path to a cleaner more sustainable energy future. Germany installs more wind power annually then your government's current target for all renewable energy sources. And last week even our neighbour Quebec committed to doubling its target for wind power. Ontario's potential is even greater.

We would like to request an opportunity to meet you as a group sometime in August to discuss our common goal of building a greener more sustainable energy system for Ontario. In particular, we would like to present to you our energy vision for the province.

We would also like to request clarification regarding your newly created authority to issue supply directives. We have attached several questions and would appreciate response from your office as soon as possible.

Again, we look forward to meeting and discussing how we can collaborate on moving toward our common goal of developing a clean, reliable, diverse sustainable energy supply for Ontario.

Ecologically yours,

Canadian Environmental Law Association
Ontario Sustainable Energy Association
Greenpeace Canada
Sierra Club of Canada
Sierra Club of Canada – Ontario Chapter
Women's Healthy Environments Network
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6. Will there be public consultation regarding any possible directives before they are issued and if there is public consultation, what form will it take?

The same support that OPG and the previous Ont. Hydro recieved, with the paying of transmission line costs would be VERY helpful to the companies that want to make commercial use of wind power.

Currently, the potential wind generation on Wolfe Island could furnish much of Kingston with power but the cost of the underwater cable must also be born by the independent supplier.

The playing field needs to be leveled and we will all benefit.

Judy Greenwood-Speers

Dear OPA

Please include a scenario with a minimum of 60% renewable electricity by 2020 and a full phase-out of dirty coal and unreliable nuclear power.

Thank you!

Aaron Hamilton
Toronto

1.3 Sustainable buildings

There are many books on architecture and on buildings with the word "sustainable" in their title, but in most cases the term "sustainable" is not defined. There are also many claims that certain buildings are "sustainable", in some cases when the buildings are only slightly less energy-demanding than buildings built according to conventional practice. Others define sustainable buildings in terms of "minimizing" energy use or the use of natural resources, although there is no logical requirement that some arbitrary level of resource use that is considered to be "minimal" will be indefinitely sustainable. As discussed by Marshall and Toffel (2005), there are well over 100 different definitions of sustainability more generally, many of which include worthwhile goals such as a higher quality of life and social justice that are separate from the issue of sustainability.

1.4.1 Defining sustainability

The *HOK Guidebook to Sustainable Design* (Mendler and Odell, 2000) lists four principles of sustainability to which "sustainable" buildings should contribute. These principles are:

- That substances from the Earth's crust must not systematically increase in the ecosphere,
- That substances produced by society (man-made materials) must not systematically increase in the ecosphere,
- That the productivity and diversity of nature must not be systematically diminished, and
- That there must be fair and efficient use of resources to meet human needs (basic needs for all take precedence over providing luxuries for the few).

These four principles, as important as they are, are not sufficient to guarantee sustainability. Furthermore, "fairness", as desirable as it may be, is not a strict requirement for some system of resource use to be indefinitely sustainable. In any case, at least two more principles are required:

- Human energy needs must be met entirely from renewable energy sources, without degrading the longterm capacity of nature to supply energy renewably, and
- The local rate of consumption of freshwater must not exceed the local rate at which freshwater is supplied through the hydrological cycle in excess of local ecological needs.

The last point, sustainability of water use, is an issue for buildings because one particular low-energy technique for cooling – evaporative cooling – consumes water. Conventional cooling techniques relying on vapour-compression chillers and cooling towers also consume water, both on-site and at the electric power plant, while absorption chilling driven by solar energy would consume even more water while saving energy. Thus, water as well as energy is an important dimension of sustainability for buildings. Efficient use of wood that is harvested sustainably is another dimension of sustainability for buildings, implied by the principle of preserving the productivity and diversity of nature. This dimension is linked to energy use in that wood can displace materials (such as steel or concrete) with a high embodied energy, and because more wood is needed in order to achieve high levels of insulation without using solid-foam insulation (which entails emission of halocarbon gases). The principle of preserving the productivity and diversity of nature also implies efficient use of land, thereby favouring compact, relatively closely-spaced multi-story buildings rather than scattered and sprawling one-story buildings, but this also has energy implications with regard to heating and cooling loads and the opportunities for wind- and thermally-driven passive ventilation, not to mention transportation energy use.

The focus of this book is on energy. A society based on fossil fuels is not sustainable for two reasons. The first and most obvious is that fossil fuels are not in infinite supply. Although, technically speaking, we will never run out of fossil fuels, at some point the remaining fossil fuels will become so expensive, and so difficult to extract, that in practical terms they will have been exhausted. The second way in which a society built on fossil fuels is not sustainable is that, as we continue to increase the concentration of greenhouse gases in the atmosphere (largely through the use of fossil fuels), the climate will continue to warm, and with it, the pressure to change course. At some point long before the fossil fuel resource has been exhausted, this pressure is likely to become overwhelming (although, unfortunately, not before substantial damage has already occurred).

1.4.2 Kaya decomposition of future CO_2 emissions

As argued above, compliance with the UNFCCC requires limiting the atmospheric CO_2 concentration to 450 ppmv or less. Stabilization of CO_2 at any concentration ultimately requires reducing anthropogenic emissions to zero, but the rate at which emissions need to be reduced depends in part on the extent to which global warming leads to accelerated natural emissions into the atmosphere (from, for example, forest dieback or decomposition of carbon stored in presently-frozen permafrost regions) that are in addition to human emissions. The expected acceleration of natural emissions is a positive *climate-carbon cycle feedback*. According to the climate-carbon cycle model simulations in Harvey (2004), global fossil fuel emission must peak around 2020, drop to 20-40% below present emissions by 2050, and be completely phased out by 2075-2100 in order to stabilize atmospheric CO_2 at 450 ppmv, depending on how strong the positive climate-carbon cycle feedback is.

Future CO_2 emissions can be written as the product of population (P), gross domestic product per capita (GDP/P), primary energy used per unit of GDP (PE/GDP), and carbon emission per unit of primary energy (C/PE). That is,

$$\text{Total Emission} = P \times GDP/P \times PE/GDP \times C/PE \qquad (1.1)$$

where PE/GDP is referred to as the *energy intensity* of the economy and C/PE is referred to as the *carbon intensity* of the energy system. Eq. (1.1) is referred to as the *Kaya Identity*, in honour Japanese scientist Ichini Kaya, who first presented this equation (**Reference?**). This equation is a straight-forward mathematical identity, but it hides a series of complex interactions. I will elaborate briefly on each term here.

Projections of peak human population have been falling over time. According to the work of Lutz et al. (2001), there is a 60% probability that the human population will peak somewhere between 7.8 and 10.8 billion by 2050 to 2085, then begin to decline, with a 20% probability that the peak will be less than 7.8 billion and a 20% probability that it will be greater than 10.8 billion. However, the future human population is to some extent something that can be determined in advance, through support for family planning and for measures (such as broadly-based socio-economic development and empowerment of women) that reduce the desire for large families.

The political culture in most parts of the world focuses single-mindedly on growth of GDP as an end in itself. However, presumably it is human happiness that is the ultimate goal, with GDP/person at best an imperfect proxy for human happiness. There is a vast policy literature on global warming that implicitly equates happiness with material consumption (in the so-called "utility" functions), but there is also a whole philosophical and spiritual literature that recognizes that, once basic human needs are satisfied, happiness is related to the diversity and richness of

human relationships (family, friends, community), health (which will be improved as a byproduct of many of the measures to reduce greenhouse gas emissions), and the preservation of cultural identity, not the accumulation of material wealth (**references?**). Indeed, there is substantial evidence that, in the USA and other developed countries, economic growth has been *negatively* correlated with various measures of human well-being and happiness for the past 2-3 decades (see the Appendix in Daly and Cobb, 1994). This does not in any way imply that significant economic growth is not needed in the developing countries in order to improve the material standard of living. However, at some point, directing increasing labour productivity into more leisure time would likely do more to increase human happiness than further growth of GDP/person. Many would argue that this point has long since been reached in most developed countries.

Energy intensity is much more than energy efficiency, as it also depends on structural changes in the economy (the relative importance of goods versus services, and of energy-intensive versus less energy-intensive manufactured products) and demographic change (which alters the mix of goods and services demanded, and so is partly redundant with structural change). Carbon intensity reflects the energy sources used - the proportions of fossil fuel and renewable energy, and the proportion of coal, oil, and gas within the fossil fuel portion.

To phase out fossil fuels by 2075-2100 requires limiting the growth in total energy demand to levels that can be satisfied with renewable forms of energy. The first three factors in the Kaya identity – population, GDP per person, and energy intensity – together determine the growth in energy demand, and all three represent important levers for reducing emissions. To illustrate the relative importance of population, GDP/person, and energy intensity, consider the following scenarios to the year 2100:

Scenario 1: High population (exceeded by only 20% of the scenarios in Lutz et al., 2001), high growth in average GDP/person (1.6% per year, the global average trend during the past few decades), and low rate of reduction in energy intensity (1%/yr, the rate of decrease for the world economy over the past few decades).

Scenario 2: High population, high growth in GDP/person, and 2%/yr reduction in energy intensity.

Scenario 3: Low population (exceeded by 80% of the scenarios in Lutz et al., 2001), low growth in GDP/person (average growth rate decreasing linearly from 1.6%/yr in 2000 to 0.8%/yr in 2100), and 2%/yr reduction in energy intensity.

Figure 1.8a shows the resulting variation in global primary power demand (i.e., the rate of use of energy as it is found in nature, prior to conversion to other forms). The difference between Scenarios 1 and 2 represents the impact of doubling the rate of reduction of energy intensity, while the difference between Scenarios 2 and 3 represents the impact of lower population and GDP/person assumptions. From Fig. 1.8a, it appears that doubling the rate of improvement of energy intensity is far more important than the alternative population and GDP/person assumptions. However, this is an artefact of the order in which the changes to Scenario 1 were made. **Figure 1.8b** shows primary power demand for Scenarios 1 and 3 along with an alternative to Scenario 2, which combines low population and low GDP/person with 1%/year reduction in energy intensity. In Fig. 1.8b, low population and low GDP/person appear as the most important factors, especially during the latter half of this century. This comparison underlines the importance of *both* energy intensity and population/economic growth per person in determining future global energy demand.

The difference between total primary power demand, illustrated in Fig. 1.8, and the primary power that can be supplied from fossil fuels without exceeding allowable CO_2 emissions, must be supplied by carbon-free power sources. **Figure 1.9** shows the amount of C-free power required in 2050 as a function of the rate of improvement in energy intensity, assuming either high population combined with high GDP/P (as given above), or low population combined with low GDP/P. Global primary power supply in 2000 was 13.3 TW (TW=terawatt, 1 TW=10^{12} watts), of which 10.6 TW were from fossil fuels and 2.7 TW from carbon-free sources (of which 0.9 TW were nuclear and not likely to be replaced as existing facilities are retired). If energy intensity continues to decrease at 1%/year, global primary demand in 2050 would be 20.7 TW and 29.3 TW for the low and high scenarios. The permitted fossil fuel use supplies 7 TW of primary power, so the required C-free primary power in 2050 is 14-22 TW and likely impossible on this time frame. If global average energy intensity decreases at 2%/yr, global primary power demand in 2050 is 13-19 TW and the required C-free power is 6-12 TW – still an awesome challenge. At 2.5%/yr improvement in energy intensity, the required C-free power in 2050 is 3.3-7.7 TW, or 2-4 times the present non-nuclear world C-free power supply of 1.8 TW. For the low population/low GDP/P scenario, the required C-free power supply in 2050 ranges from 6.0-3.3 TW as the rate of decrease of energy intensity ranges from 2.0-2.5%/year.

1.4.3 Implications for building energy intensity

Assuming that 3-6 TW (3000-6000 GW or 3-6 million MW) of C-free primary power by 2050 are feasible, that human population growth is close to the low scenario, and that growth of average GDP/person drops in half over the next century, then energy intensity reductions of 2-2.5%/yr until 2050 are consistent with stabilization of atmospheric CO_2 at 450 ppmv; otherwise, faster reductions in energy intensity are required. Global average energy intensities in 2050 would be 36% and 28%, respectively, of the global average energy intensity in 2000 - reductions by factors of 2.8 and 3.6. If the floor space of the global building stock were to grow in proportion to world GDP, and if the same reductions in energy intensity were to occur across all sectors (buildings, industry, transportation, agriculture), then reductions in the primary energy intensity of the building stock (annual energy use per unit of floor area) *on the order of a factor of 3-4* are required for stabilization of atmospheric CO_2 at 450 ppmv. This condition for stabilization of CO_2 at 450 ppmv is derived from the requirement of an energy use small enough that it can be eventually met with renewable sources of energy, so it is equivalent to longterm sustainability although, strictly speaking, an energy system does not need to evolve toward a carbon-free state fast enough to avoid overshooting 450 ppmv CO_2 in order to be moving toward sustainability.

If the building floor area grows more slowly than GDP, the energy intensity of buildings (expressed per unit of area) will not need to fall as fast as the overall energy intensity of the economy (expressed per unit of GDP). As discussed in Chapter 2 (Section 2.2), about 35% of the on-site energy used in buildings in OECD countries is electricity (generated with an average efficiency of 38%) and about 3% is district heat (generated and distributed with an efficiency of only 47%). Allowing for eventual electricity-generation and district heat efficiencies of 60-70% and 80%, respectively, would reduce the primary energy intensity of OECD buildings by 15-17%. To reduce the primary energy intensity of buildings by factors of 2.8-3.6 would require reductions in on-site energy intensity by factors of 2.4-3.0. In non-OECD countries, the level of services is smaller and will therefore grow, but energy is used much less efficiently than in OECD countries, so there should be a comparable potential to reduce energy intensity. To allow for the possibility that floor area could grow more slowly than GDP, the lower bound on the required improvement factor for on-site energy intensity can be reduced to, say, 2.0. *Thus, I shall tentatively adopt as a criterion for sustainability in buildings, a reduction in the average building energy intensity (on-site energy use per unit of floor area) by a factor of two to three.* This pertains to gross energy

demand, that is, excluding on-site generation of electricity by building-integrated photovoltaic modules, as any such power production would contribute to the 3000-6000 MW of C-free primary power that was assumed in deducing the need for a factor of 2-3 reduction in building energy intensity (rather than an even larger reduction). Also note that this sustainability criterion is dependent on specific assumptions concerning future human population and building floor area per capita.

Table 1.4 illustrates combinations of reductions in the energy intensity of new buildings and of the fraction of existing buildings that are replaced, leading to average future on-site gross energy intensities 2-3 times smaller than the current average on-site energy intensity. Scenarios with small and large growth in total floor area are considered separately for OECD and non-OECD countries, with a factor of 2 reduction in average energy intensity assumed for the case of small growth in floor area (25% for OECD countries, 100% for non-OECD countries) and a factor of 3 reduction in energy intensity assumed for the case of large growth in floor area (50% for OECD countries, 200% for non-OECD countries). More of the existing building stock is assumed to be replaced rather than renovated the larger the increase in total floor area. The greater the reduction in energy intensity of new and replacement buildings relative to the existing stock average in each region, the smaller the reduction in energy intensity required through renovation of existing buildings in order to achieve the factor of 2-3 reduction in average energy intensity. As seen from Table 1.5, a factor of two reduction in average energy intensity can be achieved in OECD countries if the energy intensity of new buildings is reduced by a factor of 4 and if renovated buildings use 38% less energy compared to the average of existing buildings. A factor of 3 reduction can be achieved if new buildings use a factor of 4-5 less energy and renovated buildings 57-51% less energy than the average of existing buildings. In non-OECD countries, a factor of two reduction in average energy intensity can be achieved if the energy intensity of new buildings is reduced by a factor of 3 and renovated buildings use 20% less energy compared to the average of existing buildings, given a doubling of building floor area. A factor of 3 reduction can be achieved if new buildings use a factor of 3-4 less energy and renovated buildings use 67-13% less energy than the average of existing buildings, given a tripling of building floor area. These are of course very rough numbers, dependent on the specific growth and replacement assumptions adopted here, but serve to illustrate the magnitude of energy intensity reductions compared to the existing stock average required for new buildings to qualify as “sustainable” with respect to energy use: *a factor of 4-5 in OECD countries, and a factor of 3-4 in non-OECD countries.* Compared to conventional practice for new buildings, the required reductions will be less to the extent that new buildings are less energy-intensive than the average of existing buildings. Renovations must achieve energy intensity reductions of one-third to two-thirds. With very careful design, high quality workmanship during construction, and intelligent and conscientious operation of the building after it is built or renovated, it is possible to achieve energy-intensity reductions of these magnitudes. The purpose of this book is to show how.

I see the turbine down at the CNE and I think why not? How about a publicly traded "Sustainable Energy" spin-off corporation or a co-op of some kind?

Margaret Hastings-James

As an Ontario resident I would like to see an increase of renewable energy sources that make up our energy mix. Coal powered power plants and the associated haze is definitely decreasing my quality of life through the poor air that I and my small children breathe when the wind is from the southwest. I would be willing to pay more per kwh for cleaner power production.

Keith Heino

Burlington, ON

Dear minister,

My proposal for any new electricity mix would include far more renewable energy than is currently proposed.
Legislated conservation measures and incentives for purchasing/replacing energy inefficient electrical devices as well as a broad public awareness campaign and a larger emphasis on education about saving energy are needed.
Market forces MUST be also be made to bear on the situation. People must be made aware that prices rise as demand rises and people and businesses should be charged for using more, particularly during peak periods.
Perhaps even a 'progressive' charge could be applied to electricity users, similar to a progressive income tax, such that the largest users are charged MORE $ per kWh than small users.
Programs must be in place that will help subsidize the cost of retrofitting homes and businesses who chose to do so provided their projected energy savings after retrofit will be above a certain level [ex. 15% or higher average savings] and the payback period (with consideration for higher prices paid for the power) is reasonable [ex .20 years]. Energy saving could also come from a massive program of subsidies for retrofits for buildings that could be in combination with guaranteed loans that would 'amortize' the pay back over a period of many years at prime or below-prime interest rates. As well, high standards much be in place for energy consuming devices and all individuals and businesses should be made to pay higher prices in the form of an 'energy tax' for purchasing energy-wasteful products.
Ontario should focus more on small-scale local, decentralized generation and should support municipalities and businesses who want to secure their own energy future within an integrated system. Small scale generation should include both small and mid-sized projects for wind, water, biomass, anaerobic gas digestion systems for municipal waste, co-generation, "clean coal", and solar (including solar electric and solar thermal) among others.
Ontario must not build more Nuclear power. It is time for Ontario to boldly step forward as the most progressive Province in Canada and truly build up a renewable energy infrastructure.
Nuclear is not a renewable and is one of the least desirable methods of generating electricity.
Ontario alone probably has enough harnessable wind energy potential to meet the entire electricity requirements of Canada.
Currently nuclear energy provides 37% of our energy mix, coal makes up 29%, hydro power 26%, natural gas 7% and non-hydro renewable sources make up about 1%. It is proposed that by 2016 Nuclear energy would comprise 55% of the province's fuel mix while non-hydro renewable energy forms will make up at least 8% and that this shift in balance will largely displace coal's role as a fuel mix within the province -- but this imbalance could be wiped out through conservation.
The potential for conservation is enormous since the volume of energy wasted is prodigious in Ontario. We could realistically be madatating a target for cutting demand and consumption of energy within the province, through conservation and efficiency measures, by about 2-1.2% per year.
This roughly matches the world depletion rate for petroleum (i.e. annual production as percentage of what is left), and would help Ontario immensely in the long term as Energy [oil] prices are likely to rise excessively over the coming decades.
(More can be learned about Global Oil depletion on the ASPO web site http://www.peakoil.net/.)

Thank you for your consideration,
Lloyd Helferty

To: OPA (Supply Mix Submissions)
Subject: support for Ontario Clean Air Alliance

To Whom it May Concern,
I would like to voice my support for the Ontario Clean Air Alliance's proposal to phase in 60% renewable energy by 2020, as well as a full phase-out of coal and nuclear power generation.
Thank you,
Cate Henderson

Hybrid Power Flow Controller - A New Active FACTS Device

While reviewing the Globe & Mail on July 13th I came across OPA's Call For Written Submissions with respect to long-term power system planning for Ontario. I am presently involved in a project related to the first issue area identified by the Ontario Power Authority – that of “Appropriate analytical planning approaches that focus on assessment of risks, environmental attributes and cost characteristics of various portfolios.”

My partner and I are setting up a technology transfer company in the field of electric power transmission. Our key technology is a new power flow controller for flexible AC transmission (FACTS). This new controller is capable of achieving performance characteristics of currently utilized controllers but at a significantly lower capital cost because it upgrades the functionality of reactive compensation equipment already existing in the power system. The device is named Hybrid Power Flow Controller (HPFC) to emphasize its ability to fully utilize passive equipment (such as switched shunt capacitors).

We believe that including the Hybrid Power Flow Controller in transmission planning studies is the key-enabling factor for its widespread adoption. We are fully aware of the complexities of system planning work and the challenges associated with including FACTS devices in the studies. The Hybrid Power Flow Controller has an entitlement to make this process easier, as we have already developed a methodology for computing its capability curves.

We would now like to help integrate this methodology into OPA’s standard toolset (e.g. programs for load flow, system security assessment, generation scheduling etc.). This integration would result in a better understanding of the Ontario power system, while evaluating potential benefits of the Hybrid Power Flow Controller, indeed any controller.

This proprietary technology, the result of a doctoral thesis at the University of Toronto, presently has been approved for patent protection in the United States and has recently filed for patent protection in Europe, Canada, Australia, Brazil, and China.

The showcase of this exciting technology is available at our web site:

http://www.hpfc.ca

If you wish to join our mailing list or would like to discuss our offer to help integrate this new methodology into OPA's standard toolset, please contact me at hhess@hpfc.ca or call 416-488-0511.

Thank you for taking the time to read this.

Regards,

Herbert Hess, P. Eng.

I have been notified that you are looking for public input into your recommendations for the future of Ontario Power. My desire is to see

- 50% renewable electricity power by 2020 (nuclear NOT being renewable)
- Investment short and long term into creating jobs and opportunities in the green energy sector
- ability for consumers to purchase and indirectly fund green power by 2006

Sean Howard

Greetings:

You may well find the answer to our provinces long-term energy supply right in the Leglislative Library.

In the late '70's, the Federal and Ontario Governments funded a study on peat fuel costing many millions of dollars.

The results were published in 1981 in a 193 page report - "Evaluation of the Potential of Peat in Ontario", (isbn o 7743-6810-1).

We could have within our borders another Alberta Oil Sands.

The report states that - south of the permafrost line - our peat fields contain the equivilent of 72 billion barrels of oil.

It's conclusions were, "We hope this will stimulate the private sector to consider peat as a serious contender to meet Ontario energy needs of the future".

The technology of producing power from peat has long been known, and it is a major source of energy in Northern Europe. In fact, just this year, Ireland opened two new plants, at a cost of almost $500 million. I I did my best on August 24/04, to advance the cause of peat, in a presentation, (which can be found in Hansard), that I made before a Legislative commitee considering our electricity problem.

How can we continue to ignore this gift of nature?

I respectfully suggest that you study this report and that you give peat an honored place in our energy supply mix.

I would welcome the opportunity of making a presentation before you, in person.

Contact:
Terry Howes

Tom Hughes

24 August 2005

Ontario Power Authority
Supply Mix Submissions
175 Bloor St. E
North Tower, Suite 605
Toronto
ON M4W 3R8

Ontario's Electricity Supply Mix

The key factors to consider in developing a supply strategy are:

- Reliability of Supply
- Cost
- Social Responsibility

Reliability

Reliability can only be achieved by providing sufficient, diverse sources of supply that can respond quickly to problems with the power grid.

Our current mix of Nuclear, Coal fired, Gas fired, Hydro Electric and emerging technologies provide a diverse supply but has insufficient generating capacity.

Unless the overall generating capacity is increased to provide a considerable over-supply, Coal fired generation is most effective in responding to peak loads and problems. Hydro and Gas fired generation can respond to a lesser degree. Other supply sources can only respond slowly or are subject to the vagaries of the weather. There are considerable proven reserves of relatively cheap coal in North America on which new reliable generating capacity could be built. On the other hand, a rapidly diminishing supply of natural gas would make any new generating capacity more expensive and vulnerable to gas supply availability.

Cost

In the long run, new Nuclear Generating Capacity may be cost effective. The Legacy of cost over-runs, bungled strategy etc. was the result of mismanagement and should not cloud future thinking. Improved Technology and competent management expertise is available to build new plants if the Government chooses to use it rather than rely on Government Bureaucrats.

Both the US and Canadian information sources project that electricity can be generated more cheaply from new coal fired generation than gas-fired generation. In the short term, next 10 to 15 years, the present coal fired plants will generate electricity at about one third the cost of new gas-fired generating capacity since the capital costs of the coal fired–plants have been written off.

New supply sources, such as wind power have limited capacity and cost more than coal or gas fired capacity.

Social Responsibility

There are two key issues to consider. Environmental/Health affects and the impact on Ontario's economy and the residents welfare. I submit that the goal should be to "Continue to sustain a vibrant economy and standard of living, while attempting to minimize the environmental impacts", rather than the other way round. Who wants to go back to the Stone Age?

In the long run people will have to "get over" their concerns about Nuclear Generation since fossil fuels will eventually run out and the "Green House" affect may become a serious issue long before supply runs out.

Gas fired-generation will result in somewhat lower "green-house" gases, but not eliminate them, as many would like us to believe. It would seem to be irresponsible to spend billions of dollars of taxpayer's money to replace the coal-fired generating plants with gas-fired plants for a small environmental benefit, while doubling the cost of electricity. This will have a severe impact on Ontario's economy and ability of the residents to sustain the present standard of living. Many more cases of poverty and sickness due to inability to pay utilities bills will result. Why replace one fossil fuel with another??

Suggested Supply Mix

The present supply mix

Nuclear	36%	Base, Intermediate Load
Hydro	26%	Base, Intermediate and Peak Load
Oil/Gas	17%	Base, Intermediate Load
Coal	21%	Base, Intermediate and Peak Load

Provides a good balance of supply from four major sources.

This supply mix should be maintained by

- Bringing on new nuclear generation as existing facilities reach the end of their life,
- Installing clean burning technology in the coal fired generating plants and/or building new coal fired capacity.

Replacing coal-fired capacity with gas will remove 25% of the supply diversity and severely compromise the ability of the system to respond to peak demands. All Ontarians should be very concerned about this.

Yours truly

Tom Hughes
"A concerned retiree"

Hydro One Networks' Response to OPA's Call for Written Submissions
Future Supply Mix for Ontario

Summary

In response to the invitation from the Ontario Power Authority (OPA) for submissions on the Minister's specific requests on the future “supply mix” for Ontario and on OPA's "issue areas", Hydro One Networks' Inc (Hydro One) recommends to the OPA to:

- Employ a diversified portfolio approach to address the 'issue areas' and to form the basis for its recommendations to the Minister on 'supply mix'.
- Consider fully the 'supply mix' impact on transmission and distribution, and
- Consider fully the existing transmission and distribution infrastructure impact on 'supply mix'
- Provide adequate support for additional investment in the grid that allows optimization of the "supply mix" once it is in place.

Hydro One would be willing to assist the OPA in performing its evaluation of transmission and distribution in developing its response to the Minister on the future “supply mix” for Ontario.

Introduction

The OPA has invited written submissions from interested parties on “supply mix” issues relevant to Ontario. In particular, the OPA requested comment on the specific requests for recommendations provided by the Minister of Energy and the specific “issue areas” outlined by the OPA.

The Minister's request of the OPA seeks:

- Recommendations with respect to future conservation targets for Ontario,
- Recommendations with respect to future additions of new renewable capacity, and
- Recommendations with respect to the appropriate mix of electricity supply sources to satisfy the remaining expected demand in Ontario with particular attention to baseload, intermediate and peak availability of energy.

The “issues areas” outlined by the OPA, in summary, are:

- Advice on the appropriate analytical planning approaches focusing on assessment of risks, environmental attributes and cost characteristics of various portfolios.
- Advice on appropriate approaches to constructing CDM portfolios for inclusion in long-term plans,
- Advice on assessments of different supply technologies and resources, and
- Advice on appropriate methods to assess the impact on the natural environment of supply options.

This submission provides the comments from Hydro One Networks on the OPA's 'supply mix' requests. The next section discusses the application of diversified portfolio

approach as the basis for the OPA to accomplish the approaches and assessments for its 'issue areas' and respond to the Minister's request. The subsequent two sections discuss how decisions on the “supply mix” could impact transmission and distribution and how existing transmission and distribution infrastructure could impact the “supply mix”

Diversified Portfolio Approach

“Supply mix” assessments currently are a popular area within the electric utility industry in North America. The increased development over the past ten years of natural gas fired generation that was stimulated by the “gas bubble” (i.e. plentiful supplies of natural gas available through a robust infrastructure of natural gas transmission and distribution facilities) has recently raised concerns among policy makers. Significant increases in the price of natural gas recently coupled with questions over continued supply availability has exposed the fundamental problem of relying heavily on one fuel for a significant portion of electricity supply. In Ontario, this problem has been compounded with diminishing diversity in the supply mix. The off-coal program and nuclear retirement has reduced the number of options and extent of availability of supply options.

As has been used in other jurisdictions, Hydro One Networks would advocate that the OPA follow a diversified portfolio approach to address its “issues areas” in determining the “supply mix” recommendations the Minister requested.

The diversified portfolio approach involves developing a complete roster of supply mix options evaluated regionally, determining a quantified risk profile for each of the supply mix options, ascertaining the covariant risks between supply mix combinations, assessing optional portfolios with respect to flexibility in meeting future change and then providing recommendations from the superior portfolios to meet the Minister's requests.

Transmission and distribution considerations are prominent in each part of a full and complete application of the diversified portfolio approach. “Supply mix” assessments will carry implications on wires infrastructure. Existing transmission and distribution will impact the “supply mix”. The next sections provide fuller amplification of such impacts.

“Supply Mix” Decision Impact on Transmission and Distribution

The description of supply mix options should incorporate implications for transmission and/or distribution. For example, one consideration in the description of a supply mix option would be where it can be located. Wind generation options located where there is reliable wind, gas fired generation located in the proximity of gas delivery infrastructure, nuclear generation located adjacent to ample cooling water supply and interties to allow optimal imports and exports are each examples of the dependency on location of supply mix options. This reinforces the need to consider “supply mix” regionally and not solely in the provincial context. This, in turn, has an impact on the new wires infrastructure required for the incorporation of these supply mix options.

The risk profile of individual supply mix options carries implications for transmission and/or distribution. Technical risks of supply mix options could drive additional

requirements for connection. Scale risk of a supply mix option could entail risks around time and scope for transmission and distribution incorporation. The social risks of a particular supply mix option may be compounded by risks associated with the connection of the facility. The risk profile of a supply mix option is not complete unless it includes the risk impact on associated transmission and distribution.

The covariant risk of combinations of supply mix options also impacts on transmission and distribution. Intermittency in the performance of some supply options (e.g. wind) could produce additional risks for load customers, existing supply mix options and other supply mix options in the same area of transmission or distribution connection. Another example of covariant risk may be the relative reliability performance of different supply mix options as manifested through their respective transmission or distribution connections. The impact on transmission and/or distribution of covariant risk among supply mix options requires careful assessment as part of this approach.

Existing Transmission and Distribution Infrastructure Impact on "Supply Mix"

There has been considerable investment in transmission and distribution infrastructure in Ontario and the current work on developing the "supply mix" should consider the value of these assets. Phases of the diversified portfolio approach should incorporate the impact of the existing wires infrastructure on the "supply mix".

The implications of existing transmission and distribution on the description of supply mix options should be clearly stated. Existing transmission and distribution infrastructure offers opportunity for easy connection for some supply mix options and not for others. Transmission connection or distribution connection will be a consideration for describing supply mix options. Features such as these from the existing transmission and distribution system need to be incorporated into the description of supply mix options.

In determining the risk profiles of supply mix options, existing transmission and distribution infrastructure can have significant impact. Implications on congestion on the transmission system could either improve or worsen the risk profiles of some supply mix options depending on their characteristics and location. Technical risk profile of other supply mix options could be improved by the synchronicity or var support from the robust, existing transmission and distribution infrastructure. These and other considerations will contribute to the risk profiles of individual supply mix options arising from the existing wires infrastructure.

Covariance of risks among the supply mix options may also be influenced by the existing transmission and distribution infrastructure. The existing wires infrastructure would affect the reliability and security of the connection among different combinations of supply options in different ways. The impact of the existing transmission and distribution infrastructure on covariant risk between supply mix options requires assessment so that the appropriate formulation of alternative supply mix portfolios can be done.

In sum, optimizing the use of the existing transmission and distribution infrastructure would contribute to reducing the risk associated with new supply mix options, and where new transmission and distribution facilities are required to incorporate new supply

options, the associated risks and benefits of developing those new facilities should be part of the assessment of the risk profile for that new supply.

As a final point, it is important to provide adequate support for additional investment in the grid that allows optimization of the supply mix once it is in place. There is no value in creating diversity and then not being able to use it due to transmission congestion.

INCO LIMITED SUBMISSION

TO THE

ONTARIO POWER AUTHORITY

ONTARIO POWER GENERATION SUPPLY MIX

August 26, 2005

BACKGROUND

Inco is a member of both the Industrial Gas Users Association (IGUA), the Association of Major Power Consumers in Ontario (AMPCO) and the Ontario Mining Association. Inco endorses the observations and conclusions of these Associations.

Inco is the second largest producer of nickel in the world and it is also a significant producer of copper and other metals. Inco's Head Office is located in Toronto, it has a research center in Sheridan Park and its Ontario production facilities are located in Sudbury and Port Colborne. As metal mining and refining is energy intensive, significant amounts of energy including natural gas, electricity and oil are consumed in Inco's Ontario Operations. Current use of natural gas is almost 7 Bcf/year (19 mmcf/d). Electricity consumption at its Sudbury operations is over 200MW of which about 20% comes from its own hydro-electric facilities with the remaining 80% being purchased from Ontario suppliers.

Inco has dedicated considerable resources over the years to minimising both the use and the cost of energy throughout its operations. This has included a number of energy conservation programs, unbundling supplier services and installing an energy management program, all directed towards reducing costs. As part of unbundling supplier services Inco now manages its natural gas transportation and storage and as a result it has taken on more risk in order to have the opportunity to reduce cost. Inco is concerned that the current headlong rush towards gas-fired generation in Ontario will increase the risks it faces without providing any increase in potential reward.

INCO CONCERNS

Inco would like to expand on a few of the issues raised in the IGUA and AMPCO submissions. These are:

- The probable increase in gas prices from recently approved gas-fired plants in Ontario plus the potential for further gas-fired plants,

- The impact on gas prices at Dawn, the Dawn Index, if this continues to be used in Clean Energy Supply (CES) contracts and,

- The changes needed in the gas and electricity markets to allow power generators to function effectively can have a cost impact and also an impact on services to other consumers.

Inco understands that all costs resulting from the Ontario Government decision to replace coal-fired plants with power generated by other sources, apparently mainly gas-fired generation will ultimately be borne by Ontario energy users. Similarly, all costs incurred for future generating facilities in the Province are expected to be borne by Ontario energy users. Therefore, in deciding the extent to which the Province will rely on gas-fired generation it should be recognized that the very large volumes required will have an impact on overall gas prices. Between now and 2025 the level of impact at any given time will depend on increased demand imposed by new gas-fired generation and the total gas supply available at that time from conventional and other sources, including LNG.

Any increase in the overall price of gas will impact all gas consumers including the power generators.

It should also be recognized that continuing to use the Dawn Index in the CES contracts would likely cause an increase in the Dawn Index and probably significant price volatility. The impact on the Dawn Index at any point in time throughout the period being considered by the OPA will depend on the volumes required for power generation and the supply available at the Dawn Hub.

Gas consumers purchasing gas at the Dawn Hub will be impacted if the Dawn Index continues to be used for CES contracts. Many may be forced to purchase gas elsewhere to avoid the higher prices and price volatility.

It is expected that if new gas-fired generation is approved as part of the Supply Mix over the period under review by the OPA there will be a need for investment in gas industry infrastructure. Large increases in gas demand for power generation will require investment to increase transportation capacity to the gas-fired plants. To allow daily balancing of gas supply to the varying demand for power generation will require investment for increased storage capacity and increased rates of injection and withdrawal from existing storage operations. Since all the good storage sites in Ontario have been developed, this is likely to be very expensive and could increase both gas and electricity prices.

Ongoing changes will also be required to the gas and electricity market rules to accommodate changing needs for power generation. These changes will result

in some costs being incurred and probably a change in the services being offered to existing customers. It will be difficult to change the natural gas rules as they are based on the North American market.

Higher gas and electricity prices, investment in transportation capacity and storage facilities and the costs involved in changes to market rules will all result in higher rates to Ontario energy consumers. Inco is concerned that too much reliance on gas-fired generation could cause irreparable harm to the Ontario economy and to the mining sector in particular.
The mining sector is currently benefiting from high commodity prices. The industry is however cyclical and lower prices can be expected in the future. One need only look to the pulp and paper industry to see the disastrous effect of high energy and low commodity prices.
Inco believes it to be important that the economics of gas-fired power generation be fully evaluated over the life cycle of any proposed gas-fired power plant using realistic worst-case gas price forecasts rather than price forecasts based on assumptions that all uncertainties will be favourably resolved within the required timeframe. As AMPCO points out, recent forecasts have been shown to be unreasonably optimistic. Liquid Natural Gas (LNG) has become an international commodity. LNG plants are not only difficult to get approved in North America, but any that might get approved will have to compete with other countries such as China on a price basis. This will only serve to increase North American prices rather than put a ceiling on them.

Inco agrees with IGUA that the gas industry is probably facing some of the most significant changes in its history, changes required to allow power generators to function effectively in supplying electricity to the IESO. While many of the changes will be required in the immediate future it is expected that more will be required as the gas and electricity markets become rationalized. Inco recommends, therefore, that changes to gas and electricity market rules should not be permitted unless there has been a full evaluation of the costs involved and all possible alternatives. The objective should be to ensure that costs are minimized and that they are recoverable over the useful life of each change. It should also be established how and from whom these costs will be recovered over the life of the change.

Inco believes that the OPA should have such an evaluation before making any decisions as to Supply Mix. It is understood that this falls within the OEB jurisdiction and that a stakeholder consultation process has been initiated to examine the changes required by the power generators. However, the costs of these changes and who will pay are specifically excluded from the current process.

The IGUA and AMPCO submissions also referred to the potential for LNG to impact gas prices. Inco is concerned that in the rush to replace most of the coal-fired generation, investments will be made that will prove to be unnecessary and

negatively affect the Provincial economy. Coal fired generation should not be phased out until the complete costs and benefits and the effect on the economic well being of the province have been studied.
Inco recognizes that the Minister's request refers to the Government targets for 2007 and 2010 but believes that the OPA should be fully aware of the dynamics of the gas industry in order to avoid adding any unnecessary costs onto Ontario energy consumers.

Inco also urges the OPA to require that all costs incurred in meeting the growing power requirements in Ontario be passed through to consumers as clearly identified costs within electricity rates. It would be unacceptable to Inco if gas consumers were required to pay some of these costs or that they are hidden in uplift or other charges.

Conclusions

The overall concern of Inco is that recommendations as to the power generation Supply Mix for the next twenty years recognise the dynamic nature of the gas industry and the many changes expected over that period as a result of diminishing supply from traditional sources. Inco will work with IGUA and AMPCO in any way possible to answer questions and assist the OPA.

COMMENTS OF THE INDEPENDENT ELECTRICITY SYSTEM OPERATOR
ON
THE ONTARIO POWER AUTHORITY APPROACH TO SUPPLY MIX

INTRODUCTION

The Independent Electricity System Operator ("IESO") is pleased to respond to the Ontario Power Authority's ("OPA") call for written submissions on its approach in developing the future supply mix for Ontario.

While the OPA and the IESO have different roles in the electricity industry in Ontario, coordination has never been more critical. It has been determined that Ontario should develop an integrated system plan aimed at ensuring that adequate demand and supply-side resources are put in place to meet Ontario's electricity needs in the longer term. The preparation of this plan will require appropriate analysis and the co-ordination of operating and investment requirements in order to provide for adequate long-term capacity and reliable operations.

Prior to Bill 100, the IESO was responsible for the 10-year forecast of Ontario electricity demand and supply and has gained valuable insight and expertise on Ontario's longer term electricity needs. This insight and expertise, coupled with our operational experience in maintaining the reliability of the Ontario grid, provides the IESO with a uniquely integrated perspective on the supply mix requirements that would meet the reliability needs of Ontario across all timeframes.

In the following sections, the IESO offers its comments on the specific "issue areas" outlined by the OPA regarding its approach to developing Ontario's future supply mix.

ISSUE #1: OVERALL PLANNING APPROACH and RISK ASSESSMENT

Objectives and Principles

A ***secure, reliable supply*** and the ability to operate effectively in the markets should be the primary objectives of any supply portfolio for Ontario. While this document focuses mainly on technical requirements, it will be vital to consider the impact of the markets in terms of their influence on operational behaviour and the potential for procurement processes and market design to create barriers to innovative technologies.

In serving these objectives, the principles of robustness, flexibility and balance should be advocated. The portfolio should be:

- ***Robust*** in that the continuing requirements for an adequate supply of capacity and energy to serve forecast demand[1] are met through the application of the relevant electricity planning standards of the North American Electric Reliability Council (NERC) and reliability planning criteria of the Northeast Power Coordinating Council (NPCC) and should consider needs specific to Ontario. It will also be important to consider the deliverability and dependability

[1] NPCC criteria require both extreme contingencies and extreme conditions to be assessed to identify the reliability risk arising from low probability/high consequence events.

of each resource type to determine the extent to which each can contribute to capacity and energy requirements.

- ***Flexible*** in that the resource mix enables overall operational flexibility of the system by providing the appropriate amount of each of the characteristics required to maintain reliability. Where applicable, the requirements could be met through appropriate consideration of alternative solutions: transmission, generation or demand-side resources. In general, the approach must be able to absorb change. Ontario's power system will undoubtedly be very different in 20 years from what we envisage today and the plan for the supply mix must be able to adapt accordingly.

- ***Balanced*** in that the risks inherent in each technology and fuel type are mitigated. It will be important during the development of the portfolio to balance the method of procurement, through capacity, energy and ancillary markets or through contracts, and the term of any contracts in order to maintain the viability of both market and contract mechanisms.

Based on recent changes and government announcements to date, the supply mix in Ontario will change significantly, potentially in the direction of what was evaluated in the IESO's latest 10-Year Outlook, as illustrated in Appendix A. This direction may guide but should not limit the OPA's efforts to determine the best approach to Ontario's supply mix.

Risk Assessment

This analysis will need to consider market aspects in Ontario, the fixed and variable costs of existing and potential supply alternatives, the operability characteristics of supply alternatives (as described under Issue #3), the environmental impacts and the impacts of transmission constraints. The IESO has the capability to assist with this analysis.

Key Considerations

The OPA will need to consider many complex factors in their analysis, including but not necessarily limited to the following:

Changing Load Patterns

- Ontario's existing generation mix was developed to meet a demand profile that was winter peaking and characterized by sharp peaks of relatively short duration. Energy limited hydroelectric generation, with significant capacity but without much energy available, suited this very well. Today Ontario is almost a balance between summer and winter peaking with summer increasingly dominating any time there is hot, humid weather. Summer peaks tend to span many more hours than the winter peaks. Summer peaks are effectively energy peaks rather than capacity peaks. In the future the trend to increasing summer peaks will almost certainly continue. This change in the demand profile has at least three implications:

    1. Peaking generation for the future must have energy sustainability. It needs to be able to operate for 10 to 14 hours a day, for many days in a row in the summer months. It will likely need to act more like what would have previously been considered to be intermediate generation.

2. There is less time available to conduct generator maintenance between peaks. Therefore, some generator maintenance must be done during peak times which increases reserve requirements. Fuel types that lend themselves to short duration maintenance and can undertake outages on short notice will be more able to take advantage of the decreasing opportunities for maintenance and should therefore be of more value than in the past.

3. Ontario will now have its peak demands in the same season as the major adjacent markets, with the exception of Quebec. We cannot assume that they will be available to make up Ontario's shortfalls when we experience extreme temperatures.

Operational Flexibility

- The portfolio must be constructed in a way that considers the impact on operations. The portfolio must contain load-following capability appropriate for all anticipated demand profiles. This would include intermediate load-following capability of the sort currently provided by our coal and hydro resources as well as fast-acting balancing capability such as that required for Automatic Generation Control (AGC).
- The lead time required to vary fuel supply arrangements for each source on a year-to-year or even month-to-month basis should be manageable from an operating perspective.
- As Ontario incorporates an increasing number of small resources that are embedded, distributed and possibly aggregated, the impact on dispatch flexibility must be considered.
- The IESO is concerned with the future management of the Province's water resources as they relate to electricity production. The flexibility in the operation of hydroelectric facilities is of significant value to the Ontario power system. The importance of this must continue to be reflected and balanced with other options which may influence provincial requirements with respect to water management. More detail on this issue is provided in section 3.3.3 in the IESO's 10-year Outlook released in July 2005.

Transmission

- The OPA needs to consider not just supply options but related implications for transmission investment and capability in arriving at a preferred supply mix. If an aim is to minimize transmission investment, then generation that can be located close to loads is clearly preferable. Fuel types, such as wind and water, have to be located where the fuel is. Large centralized energy centers will almost certainly require transmission investment. While it may make sense to continue to take advantage of the existing transmission capability, it may not prove as sensible to add generation that requires expansion of transmission or that requires the transmission to be stretched in capability without actually adding any new wire.

Price

- The expected price of electricity generation from the recommended portfolio should be considered as a significant factor.
- The risk of material variations in price should be assessed as part of this consideration.

Environmental Impacts

- We expect that environmental criteria will be prominent in the OPA's overall mix analysis.
- We would also recommend that any operating restrictions arising from such criteria be assessed. Some current examples include air emission restrictions, hydro-electric restrictions, and cooling water temperature change restrictions.

Energy Limitations

- The recommended portfolio should consider any annual or seasonal limitations from each energy source. For example, the annual energy from hydro resources can be expected to vary within a given range as a function of snowmelt and rainfall. In the past, certain fossil fuel contracts were "take-or-pay". Short term energy limitations such as those due to drought, water temperature, opacity, etc. need to be considered as well. These types of limitations can have a significant effect on operations.

Technology Risk

- The recommended portfolio should appropriately mitigate exposure to technology risk associated with new sources of energy supply. Technology risk should recognize the uncertainty associated with construction completion and longer times required to reach dependable operation.
- Technology risk should also consider the impact on operational flexibility and the potential for exposure to common mode problems (for example, shutdown of entire stations creating contingencies too large to be effectively managed).

Critical Infrastructure

- Threats to critical infrastructure are different today than they were in the past. Big centralized supply centres are at more risk than distributed supplies. However, the on-site fuel inventory of a nuclear plant may provide better fuel security than the security associated with distributed gas generators. This points to the benefit of having diversity not only of fuel type but diversity in the size and location of new supply.

Risk of Fuel Supply Disruption

- The portfolio should be constructed in a way that recognizes the threat of fuel supply disruption associated with each of the components in the recommended mix and the price analysis should recognize any mitigating actions that might have to be taken in the operating area.

Provincial Self-Sufficiency

- The recommended portfolio should recognize any societal outcomes required by the provincial or national government. Past factors have included such things as Ontario job creation, and national control of the supply chain. Future factors include national efforts to fulfill the obligations of the Kyoto accord. IESO assessments have typically assessed supply adequacy from the perspective of achieving self-sufficiency for median demand expectations.

Due to the nature and complexity of the considerations required to obtain the optimum supply mix it would be beneficial to hold a technical conference to supplement the findings of the submissions received through this request.

ISSUE #2: INCLUSION of CONSERVATION and DEMAND MANAGEMENT

Demand response is load responding to variations in wholesale market electricity prices or as directed by the IESO for reliability. Demand response is achieved through load reductions, shifting load to a less expensive period or substituting another generation or energy source for delivered electricity, all in real time. Demand-side management includes demand response as

well as other methods of load response that are not part of the IESO-administered Markets (IAM) or under IESO control.

At the wholesale level, the IESO has four demand response programs in place to manage load: Dispatchable Load, Emergency Demand Response, Hour Ahead Dispatchable Load and Transitional Demand Response. Over the past several years, interest and participation in these programs has gradually increased. Based on current experience, approximately 60% of all registered Dispatchable Load participants bid into the IAM over peak periods. The IESO is gaining increasing experience with dispatching loads off, but it is too early to gauge whether the majority of these participants would remain price responsive if they were to be dispatched off more frequently, for example at the frequency with which a generator is dispatched.

Demand response programs that are under IESO control can be considered to be part of the supply mix to the extent that they provide dependable and measurable demand reductions.

When factoring the equivalent capacity contribution of demand response into the supply mix, the actual market performance of existing programs should be included as an influencing factor in assessing the value of the capacity measure. The ease with which dispatchable and other price-responsive demands can change their operation within the market, shifting from being price responsive to being a price taker, is another important consideration in assessing the capacity benefits of such programs. They can remove themselves from a program more quickly than replacement resources can be built. This could be mitigated by requiring loads to provide a long lead time notice of their desire to remove themselves from a program.

The IESO intends to work closely with the Conservation Bureau to assist in the assessments necessary to develop load management programs that can be included as dependable capacity in Ontario's supply mix. The fastest and most challenging growth we have is the cooling load in southern Ontario. Focusing demand side measures in this area will provide a good opportunity for achieving measurable results.

The IESO, with stakeholders, is also considering a day-ahead mechanism that will allow for improved participation from the buy-side of the market and the associated increase in demand response opportunities.

ISSUE #3: ASSESSMENT of RESOURCE OPTIONS

A supply mix that maximizes the overall flexibility of the system contributes to the reliability of the grid. As such, not only the overall adequacy of resources, but also the operating characteristics of the resources should be considered. Appendix B provides an overview of the characteristics required and the ability of different resource types to provide them. It is not necessary that all resources have these characteristics, but more important that the entire supply mix has sufficient amounts of each of these characteristics. In some cases economics may dictate selecting a resource type with negative characteristics combined with another resource type that can more than offset it. For example, extensive wind and nuclear could be combined with large pumped storage projects to offset the potential surplus baseload with flexible storage and reserve capability. The following sections provide a more detailed assessment of the required operational characteristics.

Energy and Capacity Capability

Fuel Diversity

A diverse supply mix is critical for dependable resource adequacy and market efficiency. It must also provide operational flexibility, and should reduce vulnerability to fuel supply contingencies and fuel price fluctuations. The mix of supply options must be capable of meeting the peak requirements of the Ontario power system along with appropriate reserve margins. The supply portfolio must provide sufficient energy capability to be sustainable under a wide variety of conditions including extreme weather, poor hydrological conditions and tight fuel supply conditions. This last aspect may apply to new gas-fired generation during winter peak periods when gas demand and electricity demand peak simultaneously.

In developing a balanced supply portfolio to minimize fuel supply vulnerability, consideration should be given to providing dual fuel capability at plants which are unable to ensure fuel inventories without such capability.

Baseload Generation

Today, baseload generation largely consists of nuclear and certain run-of-the-river hydroelectric resources which cannot routinely be cycled on and off in response to demand fluctuations, typically "price-takers". Other contributions to baseload generation include self-scheduling and intermittent generation, such as the Non-Utility Generators. Approximately half of the generation in Ontario fits into the baseload category. In the right amounts, baseload generation is crucial to supplying a substantial portion of market demand. However, in real-time operations, if baseload generation exceeds minimum demand levels and cannot be marketed successfully to other jurisdictions, a situation known as Unutilized Baseload Generation (UBG) can occur. To bring supply and demand into balance under UBG conditions, baseload generation must be shutdown. For example, if a nuclear unit is unable to perform power reductions it will be shutdown, typically resulting in a 48 hour "poison" outage. Such shutdowns, which assist with low demand concerns, can adversely impact the ability to meet demand during subsequent peak periods until the unit(s) return to service.

Any consideration of nuclear generation additions should examine the ability of the different nuclear options to reduce power under UBG conditions, with preference going to those technologies which can better accommodate this requirement.

In future, any significant additions of gas-fired cogeneration are expected to add to the amount of baseload generation. Wind and other forms of intermittent generation will contribute as well. These types of generators have limited dispatch flexibility, and typically must be operated either at a fixed output at or near their full capability, or at a variable output not controlled by IESO economic dispatch signals. OPA specifications could influence the flexibility of new sources of baseload generation.

According to the IESO's 10-year Outlook released in July 2005, up to approximately 4,000 MW of baseload supply could be added to the existing in-service baseload facilities towards the end of the ten-year period without causing undue risk of UBG. Some of this capability will result from nuclear retirements reducing the existing baseload supply. The return of Pickering Unit 1 and Bruce Units 2 and 3 will consume about 2,000 MW of this incremental amount. The overall amount will be affected by conservation and demand side measures, load growth and any load shifting patterns between on-peak periods and off-peak periods.

Intermediate and Peaking Generation

Today, the existing intermediate and peaking generation in Ontario consists mainly of generation fuelled by coal, some gas, oil, and those hydroelectric generators with storage capability. Intermediate generation provides substantial energy and peak meeting contributions for upwards of 16 hours per day and has desirable operating characteristics arising from its dispatch capability. Peaking generation does not necessarily have the energy sustainability of intermediate generation but is important for meeting peak requirements, for supplying operating reserve and for short-term supply/demand balancing during daily load-pickup and drop-off. Approximately half of the existing generation in Ontario has intermediate or peaking capability.

Hydroelectric is loaded and unloaded as required, often in relatively small increments due to generator size, and often more than once during the day with recognition of minimum run times and shutdown times. Larger fossil-fuelled units are often committed either together or sequentially, usually once per day (occasionally more often) and are dispatched over a substantial portion of their operating range (approximately 75%) between minimum load and maximum. This approach has generally provided satisfactory load following capability. Where the dispatchable range of a particular generation type is more restricted, such as with some gas-fired plants, the commitment and dispatch processes associated with the IESO-administered Markets will have to be adapted. Unit commitment and loading may need to be more sequential rather than concurrent, resulting in loading and unloading of unit or station-sized blocks of capacity, with finer control exercised through more frequent manipulation of hydroelectric generation. This has been successfully achieved in markets such as New England, although with some impact on hydroelectric reliability.

It is important to recognize that current operating behaviour results from owners' offers, which are in response to the market in existence at any point in time. How units operate may be more reflective of market forces than plant capability. The OPA will need to consider both market and physical characteristics in the determination of supply mix.

There must be a minimum load following (ramping) capability provided by the resource mix to be able to match supply with demand on a real-time basis. Currently the largest load pick up period is in the order of 3,000 to 3,500 MW/hour or 60 to 70 MW/min.

New intermediate and peaking generation must be added to the Ontario resource mix in order to successfully phase out 6,400 MW of intermediate coal-fired generation by 2009.

Renewable Resources

Renewable resources consist primarily of hydroelectric, wind, biomass, solar, and geothermal energy sources. Only wind and a small amount of hydroelectric generation contracted under the present RFPs have requested connection to the IESO-controlled grid.

Wind generation, by its nature, has very little dispatch flexibility; only when the wind blows, can energy be produced. The diversity among wind projects selected under the RFPs will tend to moderate local fluctuations. Results of the IESO - CanWEA Wind Study previously provided to the OPA should provide useful insight into this resource.

Further utilization of wind energy can be achieved through partnering with suitable generation facilities (such as hydroelectric) or with suitable loads to co-optimize both elements of supply.

As Ontario gains experience with wind generation, the supply mix should consider actual and forecast market performance of wind resources to develop a capacity measure for the plan.

Ancillary Capability

In addition to energy, there are other essential elements for the reliability of the power system. These are known as ancillary capabilities, and the IESO in its role as a system operator must ensure that the system is able to provide for these as and when required.

Operating Reserves

Operating reserves are "stand by" resources that can be activated to meet demand on short notice. In Ontario there are three categories of operating reserves, classified according to the lead time required to activate them: 10-minute spinning, 10-minute non spinning, and 30-minute operating reserve. Minimum required operating reserves in each of these categories are established by the regional reliability council (Northeast Power Coordinating Council).

In Ontario the required reserve is typically around 1,400 MW, but this can be affected by the supply mix. For example, this amount could increase as it did early in the market to accommodate additional risks to operation. Currently about half of Ontario's resources offer to provide this service to the IESO-administered markets. Hydroelectric and fossil-fired generation types are generally best suited to provide this capability.

It will be necessary to consider the expected retirements of coal-fired generation to ensure that Ontario is able to maintain sufficient operating reserve capability.

Balancing Capability

Another important resource attribute that should be part of the supply mix is the system's ability to adjust its output on a minute to minute basis in order to balance area supply with demand. This objective is managed through automatic, small scale corrections provided under ancillary service agreements for automatic generation control (AGC).

Frequency Control

NERC has made the observation that frequency response capability has eroded over the past several years due to many factors. Some factors contributing to this include: more steam units operating on sliding pressure and other sources of supply, including dispatchable loads, vying for operating reserve revenues. Satisfactory frequency response capability is achieved through having appropriate governor response across a sufficient number of generating units, as defined in Appendix 4.2 of the Market Rules.

In order to avoid further erosion, it will be important to consider the ability of generation options to provide frequency response in determining the optimum supply mix.

Voltage support

Reactive capability to control voltage is essential for the integrity and stability of the operation of the grid. The requirement for reactive capability is mainly localized. The overall need for this capability can be met by ensuring individual sources of supply or load comply with the reactive capability and power factor requirements in the Market Rules, and by adding transmission-related reactive supply to the system. Special consideration should be given to facilities with the capability to provide dynamic reactive support over those that only provide static support. This is

critical in light of the reactive capability removed by the shut down of the existing coal-fired generation. Reactive requirements can also be met by reducing the reactive demand via improved load power factor, either through incentives or requirements.

It should also be noted that, because of the characteristics of air-conditioning load, the system requires more reactive resources during the summer than the winter, for the same total level of primary demand.

Black Start

Black Start service is provided by generators that commit to start-up and supply energy when grid power has been lost following a blackout. This is analogous to 'jump starting' the power system. In general, the IESO evaluates a proposal or defines a site on the basis of how it can fit into the Ontario Restoration Plan.

As priority restoration loads are identified, or as the system changes, Black Start requirements may also change. Special consideration should be given to generation facilities with the capability to provide Black Start Service, especially those in close proximity to restoration priorities.

Interconnection Capability

Ontario is part of a broad interconnected North American electricity market. The province has benefited substantially from the interconnected network, both in terms of reliability and reduced costs, by having access to firm imports to meet supply needs during changing conditions. The capability to supply from interconnected systems is essential during adverse conditions such as those experienced during the past summer. This capability is not presently assessed as contributing to meeting overall capacity requirements; rather it is used to manage the risk of insufficient supply that can occur under adverse circumstances regardless of prudent planning. Ontario would benefit from increased capability to contract for supply and the overall increased market opportunities that would be derived from expanded interconnection capacity.

Intertie contracts should only be relied upon as part of Ontario's supply mix if they are guaranteed to be at least as reliable as Ontario supply and only to the extent that a sufficient amount of capability remains on the tie lines to deal with exceptional circumstances.

When considering future supply mix and supply security, a scan should be made of surrounding markets to minimize the chance of a single threat crippling our whole region. For example, if we were going to rely heavily on Manitoba and Quebec water power, the risk of common drought needs to be considered and appropriately mitigated. Regional coincidence of gas supply shortages may be another area where our risk and the risk of our neighbours are the same.

ISSUE #4: ASSESSMENT of ENVIRONMENTAL IMPACTS

Ontario currently limits energy supplied by sources deemed to have an undesirable environmental impact. These limitations are implemented through restrictions of hydroelectric output, emissions and cooling water temperature changes. These restrictions are considered when determining the extent to which supply sources can contribute to capacity requirements.

The consequences of present and future environmental limitations must be considered in determining the capacity contributions of affected sources. More importantly any loss of operational flexibility resulting from environmental constraints must be mitigated through other sources in order to maintain reliability.

CONCLUSION

Maintaining the reliability of the Ontario power system is one of the most critical roles of the IESO. Close co-ordination between the OPA and the IESO will be essential to ensure that the future supply mix will meet Ontario's reliability needs across all timeframes.

This will entail that a secure, reliable supply with the ability to operate effectively in the markets be the primary objectives. These objectives will be best served by an integrated system plan that is robust, flexible and takes into account a balanced portfolio mix.

The IESO appreciates the opportunity to participate in this challenge undertaken by the OPA and to contribute to achieving a secure and reliable supply for Ontario. This submission provides commentary on supply mix elements that must be considered in the development of the Integrated Power System Plan. At this time we have not tried to quantify the many permutations of supply mix that might satisfy the identified criteria, but please be assured that the IESO is committed to providing assistance to the OPA as it refines the range of options.

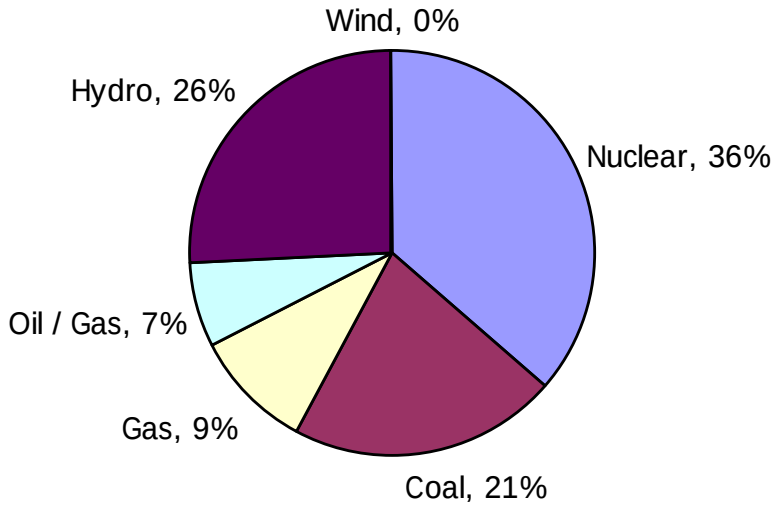
Respectfully submitted,

Derek Cowbourne
Vice President, Reliability Assurance
Independent Electricity System Operator
655 Bay Street, Suite 410
P.O. Box 1
Toronto, ON M5G 2K4

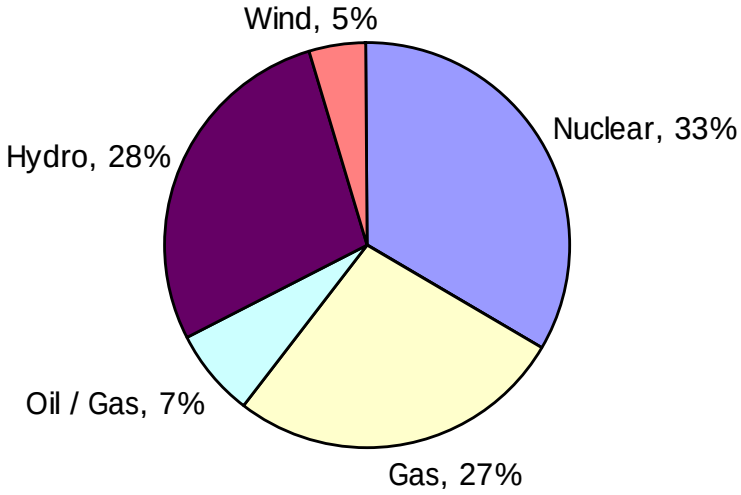
Submitted on this 26^{h} day of August, 2005

Appendix A: IESO's 10-Year Outlook (July 8, 2005)
Fuel Mix Scenario: 2005 and 2015 Coal Replacement

2005 Installed Capacity by Fuel Type



2015 Predicted Installed Capacity by Fuel Type*



*Based on the requirements identified in the July 2005 10-Year Outlook. This does not reflect the supply gap predicted for the year 2015 in the 10-Year Outlook.

Appendix B: Cross-Reference of Resource Types and Operational Characteristics[2]

Characteristics / *Resource Types*	Supply Type	Load Following Capability	Operating Reserve[3]	Black Start Service	Reactive Support	Automatic Generation Control
Natural Gas – Single Cycle	Intermediate or Peaking	Good	Good	Good	Good	Good
Natural Gas – Combined Cycle	Intermediate	Good	Good	Moderate	Good	Moderate
Cogeneration	Baseload	Poor	Poor	Moderate	Good	Good
Nuclear	Baseload	Poor	Poor	Poor	Good	Poor
Hydro-Electric (including pumped storage)	Peaking	Good	Good	Good	Good	Good
Hydro-Electric (Run of River)	Baseload or Intermittent	Poor	Poor	Good	Good	Poor
Clean coal (coal gasification, fluidized bed, etc.)	Intermediate	Good	Good	Good	Good	Good
Wind	Intermittent	Poor, only through constrained operation[4]	Poor, only through constrained operation[5]	Not applicable	Moderate	Not applicable
Biomass	Variable, depending on fuel source	Good	Good	Moderate	Good	Moderate
Demand Response	Intermediate or Intermittent (voluntary programs)	Moderate	Good	Not applicable	Not applicable	Not applicable
Demand Management	Intermittent	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
Interconnections	Intermittent or Peaking (emergency purchases)	Moderate with appropriate market transactions in place	Good	Moderate to good (provided not blacked out)	Poor, support is localized to points of interconnection	Moderate to good

[2] The characterizations provided in this table apply to facilities participating in the IESO-administered markets.
[3] Individual facilities must meet the applicable requirements in order to provide Operating Reserves in the IESO-administered markets.
[4] Wind resources cannot follow load in the same manner as a typical load-following resource, rather they can be constrained off as a means of reducing generation. This is only likely to occur when all other resources are exhausted.
[5] Wind resources cannot be constrained up to provide operating reserve. Instead they can intentionally hold back their production to create reserve but this would probably not be considered an economic use of the resource.

AUG 2 2 2005

IGUA/ACIG

19 August 2005

Ontario Power Authority
Supply Mix Submissions
Suite 606, North Tower
175 Bloor Street East
Toronto, ON, M4W 3R8

Dear Sirs:

GENERATION SUPPLY MIX

Attached is a submission by IGUA to the Ontario Power Authority which sets out certain concerns of IGUA's industrial natural gas end user members with regard to the Province's phase out of coal-fired generators and their replacement, in part, by natural gas fueled generators.

IGUA recognizes that the focus of the OPA's review covers a variety of important subjects and that the review horizon extends well beyond the next five to ten years. The concerns which IGUA's members wish to convey address a much shorter time-frame ... the next three to five years. By 2010, IGUA expects that some of the projects announced to deliver offshore LNG to receiving terminals on the lower St. Lawrence and in the Maritimes will have come on line. In addition, there is hope that the MacKenzie Valley Pipeline will have been approved and deliveries of Mackenzie Delta gas supplies into the Western Canadian grid will have either commenced or be due to come on stream shortly thereafter. These natural gas supply developments will have a profound impact on natural gas flows in Canada, and hopefully will provide relief of the current very tight gas supply situation facing Ontario today.

The purpose of IGUA's submission is to identify problems that the off-coal program may cause for industrial natural gas end users, who must compete with the power generators for natural gas supplies, pipeline transportation, storage and gas distributor services. In particular, there is scope for added cost burdens imposed on all natural gas users in Ontario if the nature of the gas delivery service for power generators does not recover from the power companies all of the costs associated with the provision of service to them.

Yours truly

Peter L. Fournier
President

Industrial Gas Users Association, 1201, 99 Metcalfe Street
Ottawa, ON, K1P 6L7 Ph: (613) 236-8021 Fax: (613) 230-9531

Industrial Gas Users Association

Submission To

The Ontario Power Authority

Regarding Generation Supply Mix

General

The Industrial Gas Users Association (IGUA) appreciates the opportunity to provide input on behalf of its members into the planning of Ontario's future electrical energy supply. IGUA believes strongly that the potential impact on the gas industry and on gas consumers should be taken into consideration when deciding on future supply mix.

IGUA was established in 1973 to represent industrial natural gas users before regulatory tribunals and governments at both the national and provincial levels. IGUA continues to provide a coordinated and effective voice for member companies located in Manitoba, Ontario and Quebec all of which are major users of natural gas as a fuel or feedstock. IGUA has 45 members, grouped in five categories: Pulp & Paper, Metals, Mining & Smelting, Chemicals and Other. Thirty four IGUA members are located in Ontario and they expect to consume about 75 Bcf of gas in 2005. These companies directly employ about 40,000 Ontario residents and by extension, another 300,000 to 400,000 jobs in Ontario are supported by IGUA member activity in the province.

The Supply Issue

IGUA perceives that Ontario's energy decision makers have assumed that natural gas will always be available to meet the demands for gas-fired generation if it is to replace coal or for any additional Ontario power generation requirements. Further, there seems to be an assumption that the appropriate natural gas infrastructure is either already in place, or that it can readily be put in place to deliver gas to wherever the new generating facilities will be located. While these assumptions are not incorrect, they fail to recognize the potential impact on the current Ontario natural gas end user community that the creation of a large new demand for natural gas could have on gas prices and on the cost of natural gas distribution.

IGUA acknowledges that the forces of supply and demand will ensure that parties willing to pay the prevailing price of a commodity will be able to acquire it. However, when that commodity is in tight supply, it is inevitable that increased demand will drive the price higher, and consumers unwilling or unable to pay the higher price will leave the market. Today, natural gas is already in tight supply. The current prevailing price for natural gas is triple what it cost only several years

ago. Imposing a new level of demand for natural gas, as represented by the proposed new power generation projects, will exacerbate that price growth. If the provision of pipeline transportation and gas distributor delivery services to the new power plants requires pipeline and/or distributor capital investment that is not wholly borne by the power projects, then other end use customers will be burdened with such costs, further increasing the delivered cost of natural gas to the Ontario market.

IGUA suggests that all of the problems associated with supply, transportation, distribution and storage of gas should at least be examined and questions relating to costs and who pays dealt with before decisions are made with respect to future supply mix. Our current evaluation of the CES contract is that implementation will be almost impossible under current market rules and that considerable investment and many operating changes in the gas and electricity industries will be required. IGUA is concerned that some of the questions relating to "who pays" for the investment and what the impact will be on existing customers have not even been asked, let alone answered.

IGUA recognizes that the Ontario Government's energy policy has placed us on a path which will create a large, new requirement for natural gas in the Province for power generation. That new demand will require some 500 mmcf/d of new supplies of natural gas by 2008 and possibly much more by 2015 should the OPA recommend that future incremental supply of electricity in Ontario be mainly sourced from gas fired generation.

To put these numbers into perspective, it appears that the 500 mmcf/d represents an increase of about 17% over current average demand in Ontario and about 7% over current total Canadian consumption. Increases of this magnitude will almost certainly result in disruptions in the gas market and probably deterioration in the quality of service to industrial customers.

It is questionable if natural gas reserves in North America and supplies from offshore will be sufficient to sustain a demand growth of this magnitude plus the expected demand growth across North America without incurring an impact on gas prices. At the end of the day, supply and demand will always balance, and in periods of tight supplies, markets prepared to pay high prices to secure supplies will be served. As history shows us, however, it is at times of high gas prices that the industrial sector takes the primary hit, through demand destruction. Ontario must decide whether it wants to rely upon an energy source for its future electric power generation requirements that is bound to feature extensive periods of tight supplies with high prices and the potential for extreme volatility. If it does, the result will be reduced industrial activity in the Province.

As noted earlier, IGUA is concerned that the Ontario Government has entered into CES contracts with a number of power generators with the Dawn gas price index, the HOEP and the 3 hour pre-dispatch price being used to decide when

the plants should run. As the electricity industry is virtually on a real time basis and the gas industry is on a day-ahead basis these contracts can only be implemented if significant changes are made to the operating practices of one or both of these industries.

If CES contracts are used for future power generation contracts then very large volumes of gas will be purchased at Dawn and it is obvious that not only will the Dawn Index will be pushed higher but there will be significant price volatility, especially when electricity demand peaks in summer and winter. Obviously the power generators can pay the higher prices as they will be passed through to the IESO, but other purchasers, including industrial consumers, may be forced out of that market.

IGUA previously submitted to the OPA its concerns with respect to the contractual arrangements the new power projects may be making in respect of acquisition of gas supplies and of transportation upstream of the gas LDC franchise area. For continuity, those comments are reproduced below, as they are also related to the generation supply mix issue.

IGUA believes that there is a disconnect between power generation planning and the realities of the natural gas transportation and distribution system. IGUA is not particularly concerned about the impact of the announced projects in the Lambton county area as they are close enough to the storage and supplies of the Dawn Hub to have little impact on the rest of the pipeline transportation and gas distribution operations. That cannot be said, however, for the plants to be located East of Dawn, especially those to be constructed in the GTA - Golden Horseshoe region ["GTA/GH"].

It should be recognized that gas LDCs such as Enbridge Gas Distribution ["EGD"] do not necessarily contract for sufficient gas supplies to meet peak day demand levels. Rather, they rely on storage deliveries, plus the ability to curtail interruptible industrial customers when necessary, to supplement day-to-day pipeline deliveries into the GTA/GH. Industrial consumers contract for interruptible service because it is less expensive than firm service and because they can accommodate the expected number of days of curtailment in the winter. The curtailment of industrials have, to-date, been driven by weather-related conditions as well as security of system supply considerations [the need to re-fill storage following a sustained cold spell when storage volumes have been drawn down to levels which would limit future storage withdrawal volumes]. Interruptible industrials accept the levels of curtailment they have been facing, can plan their energy requirements on that basis, and would continue to contract for interruptible service if the economics continue to make that a prudent decision.

IGUA is concerned that the gas supply, pipeline transportation and distribution arrangements needed to serve the new power generation market will disrupt the current level of service for industrial users of gas. Future supply mix should

recognize this and gas supply and transportation arrangements needed for new power generation should not be allowed to cause increased interruptions of industrials. Such increased interruptions could occur if power generators are not required to deliver to the LDC franchise area the daily volumes of gas needed to operate the power plants.

Power generators should not be permitted to merely deliver gas to the LDC at Dawn, when there is insufficient transportation between Dawn and the GTA/GH to serve both the non-power generation market and the power plant needs. If the total gas demand in a given area exceeds the supplies of gas available in that area the LDC must do something to balance gas receipts with gas deliveries. The LDC is required to serve residential, commercial and institutional markets first, without curtailment. Therefore, if the combined industrial and power generation gas demand exceeds the remaining gas supply the LDC must curtail someone.

It would be unacceptable to IGUA that interruptible industrial customers should face increased curtailments driven by the power generation sector. Presumably, the power generators expect to receive natural gas to operate their generating plants as and when required. However, unless they are required to hold some form of firm service at the LDC level, including a requirement by the LDC that the power generation customers deliver to the LDC the full gas supply required by the power generators, there will be a disconnect between power plant operation and the traditional operation of the gas LDC systems.

The risk of increased interruption of the industrial sector would be removed if the power generation sector is required to deliver sufficient gas volumes to the LDC franchise area on days when they are operating and have transportation at the LDC level. This requires two things:

(1) That the power generation companies contract for sufficient firm gas supplies to meet their operating load requirements.
(2) That the power generation companies contract for firm pipeline transportation capacity to permit firm delivery of gas supplies to the LDC franchise area and capacity at the LDC level to deliver to the plants.

If industrials experience increased curtailments of deliveries of natural gas, the following is likely to result:

(1) Some industrials will switch from interruptible service to firm, reducing the flexibility of supply currently enjoyed by the LDCs from this class of service.
(2) Some industrials will find the increased costs for gas supplies, coupled with greater risk and frequency of interruptions unacceptable, and will therefore either reduce operations or close down.
(3) Some industrials will switch permanently to an alternative fuel, typically coal or heavy fuel oil.

Recommendations

In evaluating future supply mix it is recommended that the OPA consider addressing the following impacts on each sector of the gas industry, including investment and operating practices, and the potential overall impact on the end users in Ontario.

Transportation

Pipelines that transport gas to Ontario will need to be expanded to accommodate the increased throughput. In addition, if the new power plants are not on-line at all times (which we understand will be the case), then pipeline capacity dedicated to their service will be idled when the power plants are off-line. The short-notice nature of the power plant operations will likely preclude use of that pipeline capacity during off-periods by other pipeline users. Someone has to pay for carrying that pipeline capacity when it is not being used to serve the power market. The issue is to ensure that the pipeline tolls paid by the power generators will recover all of the pipeline transportation costs associated with the services provided to the power plants, such that other shippers are not required to unduly subsidize the power generators.

With the new power company loads, pipelines will probably operate at load factors higher than at present. While this will result in lower firm service tolls for all pipeline users, it will also mean that there will be less scope for the pipelines to offer other services, including interruptible service and diversions, which are today important components of the pipeline services used to meet Ontario's natural gas market needs. Customers who currently use interruptible pipeline capacity to move some or all of their Western Canadian gas supplies to Ontario, including industrial consumers, will be faced with a reduced availability of interruptible service. That will translate into higher costs, as interruptible service is sold on a biddable basis and higher bid prices are inevitable. The alternative – contracting for firm service – entails higher costs as demand charges are incurred 24/7 regardless of throughput usage.

Current operating practices, including nominations and the use of storage, will need to be changed. The challenge is to accommodate these changes without negatively impacting existing customers

Storage

If storage becomes a key element for the gas-fired generators as some are suggesting, then further investment in new storage capacity will be needed to meet the power sector's requirements for storage space including provision for the necessary rates of injection and withdrawal.

Traditionally the LDCs have made any investment required for storage facilities. If this practice continues, it will be essential that other customers are not required to subsidize the power generators.

The Natural Gas Forum showed that there is some support for the OEB forbearing with respect to regulation of storage. This would mean that the OEB would no longer regulate storage and the LDCs would be able to offer storage at "market rates", currently about twice the cost of the regulated rates. IGUA believes that the OEB should continue to regulate storage until it can be demonstrated that all costs related to storage for power generation is borne by the power generators. The expectation is that if all Ontario storage were offered at market rates then all Ontario consumers would face increased costs, either directly or through balancing charges included in bundled rates.

Distribution

The impact at the distribution level will depend to some extent on the location of individual customers and where generating facilities are located. Changes will be required to gas distributor operating practices, if the provisions of the current CES contracts are applied to the terms and conditions of gas delivery service to the power projects. Changes to current operating practices will involve the nomination process [how customers nominate for their gas service needs, currently on a day-ahead basis], customer balancing requirements, and perhaps most importantly, the LDCs own gas supply management operations. In respect of the latter, the gas LDCs will have to put measures in-place to allow them to meet the very short-notice gas service requirements of the power generators, while at the same time not disrupting service to the rest of their customers. These changes may need to set certain requirements for upstream pipeline delivery requirements for the power plant operators, and may need to address access to storage on a daily basis to accommodate balancing requirements.

IGUA considers it important to ensure that such changes can be implemented in a manner that other customers are not adversely impacted before placing too much reliance on gas-fired generation.

Conclusions

It is evident that the gas industry is probably facing some of the most significant changes in its history. In addition to the probability of commodity price increases there is the possibility of substantial investment being required as well as many changes in operating practices.

Considerable effort will be required to minimize disruptions to current consumers and to ensure that they are not required to subsidize the growing power generation segment.

IGUA will be happy to answer any questions and it is also prepared to expand further on its concerns and to work with the OPA to assist in resolving those concerns.

Intelaport Networks Inc

18 Hawthorn St
Belleville ON
K8P 5M5

Phone: 416 402 9516
Fax: 613 962 6084
Email: michael.freeman@sympatico.ca

CDM

thru
Conservation
and
Residential Generation

by
Michael R. Freeman

HOME ENERGY makeover
Comfort • Savings • Efficiency

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1.0 BACKGROUND

The power requirements of several sectors of the marketplace have spawned technologies which have not been utilized on a wide basis for home energy production.

The IT industry and its need to back up data and continue processing have spawned standby power, which is both reliable and safe.

The recreation and marine industries have taken this technology for use independent of utility grids producing their own power while underway and storing it for use when their engines are stopped. These living spaces also use renewable energy sources like wind generators and PV arrays to produce and store power when they have no engine to charge up.

Connection to the grid is also provided as part of the energy system.

Co-generation has been applied to industrial and commercial applications with great success driven mainly by economics.

The combination of all these products, which are reliably serviced in each sector, have created the opportunity to make every residence a net generator of electricity, cost effectively, when applying the huge costs of capacity expansion combined with the reduced cost of conservation and generation.

2.0 Conservation

The obvious first step to any residential program is to reduce the amount of energy required to the lowest common denominator of use while maintaining and improving comfort and convenience. Renovations which do not meet this criteria will soon be abandoned and inefficient practices resumed.

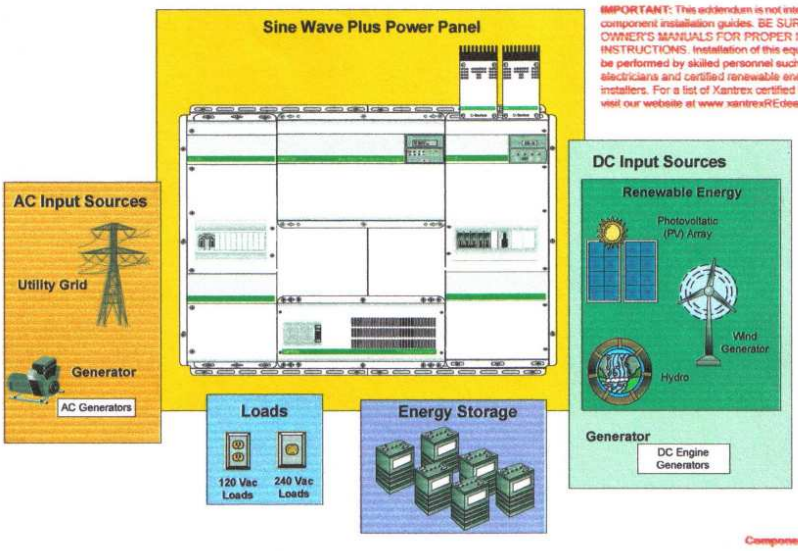
Measures, which attain this goal, are well documented but have not been widely successfully deployed due to affordable energy costs and lack of easily accessible payment programs.

The COMPELLING VALUE PROPOSITION must be marketed to the customer. Without it there will be no buy in to any products and services.

3.0 Inverters and Standby Power

Again invented for the IT market but turned into a consumer product by the RV and Marine markets, the Inverter and Battery is now a low cost reliable product which can be easily applied to homes and businesses for not only standby power but as a controllable delivery medium to the Residence.

Single Inverter Configurations using a TX Autotransformer (120 to 240 Vac Applications)


Sine Wave Plus Power Panel
IMPORTANT: This addendum is not intended to replace the component installation guides. BE SURE TO READ THE OWNER'S MANUALS FOR PROPER INSTALLATION INSTRUCTIONS. Installation of this equipment should only be performed by skilled personnel such as qualified electricians and certified renewable energy (RE) system installers. For a list of Xantrex certified RE dealers, please visit our website at www.xantrexREdealers.com.
AC Input Sources
Utility Grid
Generator
AC Generators
DC Input Sources
Renewable Energy
Photovoltaic (PV) Array
Wind Generator
Hydro
Generator
DC Engine Generators
Loads
120 Vac Loads
240 Vac Loads
Energy Storage
Components sold separately.

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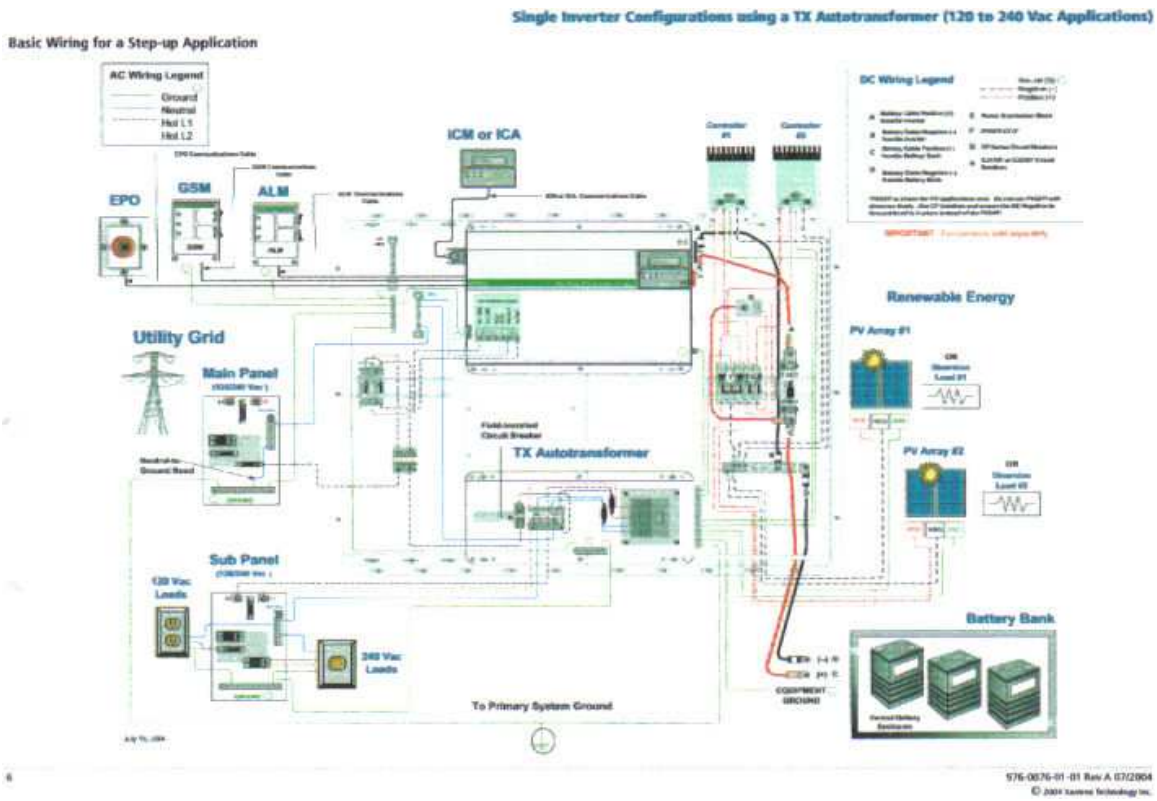
The diagram shows that many sources of generation can be hooked to one main supply and those sources are selectable.

Varying voltages are available which overcomes the use of 240v and 120v appliances at the same residence.



This diagram shows the wring for a typical 120/240 volt residence.

These systems are available from a wide number of manufacturers and widespread deployment will reduce costs dramatically as with any electronics market penetration.

Suffice to say that with current battery technologies, (on the low end Golf Cart lead acid and on the high end hybrid car batteries), cost effective, controllable standby power is available for use by the utility to control demand home by home.

Using a Smart Meter and its communications network the OPG can easily control each home during periods of high demand, switching between off grid, base charging on grid or charging by other generators (PV, wind or CHP) in order to meet each home's power requirements while at the same time meeting the OPG's demand requirements.

The customer also gets great value. With this system they are able to have standby power at all times. Protection from blackouts and small power interruptions would be seamless.

The customer can also avoid on peak consumption by using the grid when the power rates are lowest so that the energy bill goes down.

4.0 COMBINED HEAT AND POWER (CHP)

Several manufacturers such as Honda are now offering CHP units to the marketplace. In fact Honda has 15,000 units installed in Japan and is beginning to market in the US.

Other manufacturers offering a wide variety of product have also entered the field and Technology Assessment has been done in Ottawa on one product.

Suffice to say that with proper product selection each home in Ontario could be a net generator of electricity while meeting all of its other energy requirements during most of the heating season.

Canadian Centre for Housing Technology | Centre canadien des technologies résidentielles

Development of Micro Combined Heat and Power Technology Assessment Capability At the Canadian Centre for Housing Technology

Bell, M.; Swinton, M.; Entchev, E.; Gusdorf, J.; Kalbfleisch, W.; Marchand, R.; Szadkowski, F.

B-6010

December 8, 2003

Canada

Executive Summary

In 2003, Natural Resources Canada, National Research Council Canada, and Canada Mortgage and Housing Corporation developed and demonstrated a test facility at the Canadian Centre for Housing Technology (CCHT) which incorporated the capability of assessing residential micro combined heat and power (CHP) systems under real-world conditions. The intent of the project was to adapt one of two existing research houses at CCHT to integrate a prototype CHP unit that would provide some electricity and heat to the house, and supply surplus electricity back to the grid. Documentation of the adaptation and CHP operation, including building integration issues and CHP performance characteristics, were key objectives, with the intent of providing valuable information to CHP manufacturers and researchers alike.

The CHP unit chosen for this demonstration was the Whisper Tech Ltd. Stirling engine, fuelled by natural gas. The unit had a small electrical capacity (750 W) and a larger thermal output (6.5 kW). It was designed to be 'heat-driven'- controlled according to heat demand of the residence, so that electricity generation is a by-product. The unit was installed as a grid-connected device, with local electrical inspections performed.

The Test House at CCHT, a fully automated and monitored house, was adapted to allow waste heat from the CHP unit to be collected, stored and used to meet space and water heating loads of the house. This portion of the CHP system was referred to as the 'Balance of Plant' (BOP). As well, the house's electrical wiring was reconfigured to permit the CHP generator to provide electricity to both the house, addressing a portion of the house's electrical needs, and to the electrical power grid, on occasions where the house loads were less than the CHP unit electrical output.

The CHP unit was then installed in the basement of the Test House and connected to thermal and electrical systems. The existing house thermostat on the main floor wall, and the programmed demand for hot water ultimately controlled the CHP's BOP by calling for heat from the system. Controls in the BOP signalled a need for heat from the CHP unit when heat stores were being depleted. The CHP generated electricity simultaneously whenever there was a demand for heat. Installed meters kept track of how much electricity was being generated and where it was going, whether to the house, to the grid or both.

Operation of the house with the CHP unit occurred between March and June 2003. Both the house performance and the CHP system were monitored extensively. Outdoor conditions ranged from late winter to summer conditions in the Ottawa area. This allowed the CHP unit performance to be assessed under a range of space heating loads, as well as a daily profile of water heating loads associated with the CCHT Test House operation. (The house features a simulated occupancy in which all major appliances and water using devices were used under a realistic schedule).

Results showed good performance of the CHP unit, with many scenarios or combinations being tested over the monitoring period. The CHP unit was observed to supply all of the space and water heating loads in most circumstances, requiring heating backup in a few instances during CHP unit shutdown. The CHP unit was shown to provide a considerable percentage of the house's electrical requirement, 43% in one example, and even exported 6% of its electricity generation back to the grid in that same period.

The overall performance of the CHP system was shown to compare favourably with the efficiency of domestic combination space and water heaters fired by natural gas, e.g. about 82% total efficiency of the CHP unit, with 6% of the inputs going to electricity generation and 76% going to heating on average. The heat storage and distribution system designed for this demonstration averaged about 57% efficiency resulting in a total CHP system efficiency of about 50%. All efficiencies were noted to be higher in colder weather, when the heat was better utilized, and resulted in fewer standby losses. Better optimization of the BOP may be needed (possibly a one tank system) to reduce standby heat losses.

Some of the issues addressed but not necessarily resolved over the course of this study included:

- The variability in acceptance by local utilities across Canada of the concept of feeding electricity back to the grid on a micro level. (This was not a problem in our jurisdiction as the NRC campus already has a co-generation plant in operation).
- The cost of electrical modifications for an actual house (as opposed to our test house) – estimated to be of the order of $2k to $3k.
- The need by the Canadian Electrical Code of an 'external, weatherproof, lockable disconnect' to allow the power utility to manually disconnect the CHP from the grid during periods of power failure and repair. This requirement is to protect linesmen from uncontrolled sources of power to the grid during line repair. This feature was included in our design, but the 200 amp service originally installed to give us flexibility for growth of the electrical system necessitated a more robust and expensive disconnect than may normally be required.
- The cost of the CHP unit itself - ours was $12k US for the prototype unit. Current models cost approximately $7.5k US.
- Issues relating to reliability, durability, and value of the electricity generated were discussed within the context of 'return on investment' or 'payback', but these were not examined in detail.
- The long warm-up period for the CHP unit to start generating electricity after shutdown (e.g. about 30 minutes).
- The design and control of the Balance of Plant (for heat storage and distribution) to minimize shutdown of the CHP, and maximize the overall efficiency of that part of the system.
- The role of a heat-driven CHP unit in the summer, when the thermal load is small and the BOP heat losses to the house are relatively high.
- Whether or not a backup burner (in the form of a water heater in our case) was needed to address all space and water heating loads of the house.

The Whisper Tech Ltd. CHP was used to demonstrate the CHP testing and monitoring capability of the converted CCHT house. While the testing of the WhisperGen itself was not intended to be exhaustive, the performance of the CHP during the demonstration suggests that the system has promise and merits follow-up work to address the above issues.

It was concluded that this project met all three of its objectives, including

- the successful adaptation of the CCHT test house to integrate a micro CHP grid-connected system;
- quantification of the CHP unit and overall system performance for a range of conditions spanning late winter to summer conditions in Ottawa; and
- collection of information and development of experience in installing, commissioning, monitoring and analyzing the performance of residential cogeneration systems in houses.

Honda Complete MCHP System

Honda Complete MCHP System.

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New 40,000-Hour Engine Offers Promise

A new low-emission micro-CHP unit designed to operate for 40,000 hours between overhauls has entered the electric generation engine marketplace. If successful, the technology could end up setting a *de facto* price cap for residential fuel cells.

Ecopower Micro-CHP Unit

The unit, developed by Marathon Engine Systems [http://www.marathonengine.com/cogeneration.html], East Troy, Wis., is being tested in the United States in combined heat and power applications after successful deployments in Europe.

The 5 kW ecopower micro-CHP unit includes an inverter, can run on natural gas or propane, and offers electrical generation efficiency of 25%. A built-in thermal recovery system can add an additional 65% to the unit's overall efficiency. Actual efficiency depends on the customer's heat requirements. The unit has a sound level below 56 dB, quieter than most heat pumps or even refrigerators, according to Michael Cocking, Marathon sales manager.

Developers have sought for quite some time a long-lasting gas engine for heat pumps and combined heat and power applications. Marathon touts the unit's long life and low maintenance requirements. The 5k combustion engine is designed to last 40,000 hours between overhauls.

"Scheduled maintenance is needed only every 4,000 hours," says Cocking. This consists of an oil change, using 3 gallons of a special oil; replacement of the oil and air filters, and spark plug with wire, all costing less than $150 for materials and an hours labor.

Units running continuously would require maintenance twice a year, but smart electronics in the engine sense electrical and thermal load and can power it up only when needed—such as during the daytime only—to reduce the engine's annual maintenance and to increase site life, Cocking explains.

Battelle Labs invented the 5K engine in 1988 to be incorporated in heat pumps. Marathon bought the rights to manufacture the engine in 1998.

Marathon's 5 K Engine

Potential customers often compare these CHP units to small backup generators that cost less than $1,000, but Cocking notes that the typical residential backup generator is designed to run only a few hundred hours a year and has less electricity output and lower efficiency than the Marathon unit.

"The Marathon units provide a clearly attractive, low-cost alternative to residential fuel cells," says Dick McClelland of Energy Signature Associates, a Pittsburgh, Pa., consultant on fuel cells and microturbines.

Ecopower units will be sold in the United States for $12,500, not including installation. Marathon's German partner, PowerPlus Technologies, has installed 700 units in Europe for grid parallel operation only. Models designed for the U.S. market also will also provide grid independent and backup power.

Tests of five ecopower units are under way in the United States, mostly in the Midwest. The first unit provides electricity at a truck dealership with space heating as a secondary product. A second unit has been installed at a residence in hybrid configuration with solar cells to recharge the home's battery bank when the sun is not available. Two additional sites are expected to be operational by fall 2005 at residences. Marathon is pursuing Underwriter Laboratories-type approval for sales of the unit within the United States.

Marathon also produces the Minotaur 2500, a complementary grid independent unit that uses a 5K engine to provide up to 5 kW of electrical power. This unit has optional thermal output and is targeted for use in remote AC or DC power applications such as residences, agricultural uses, telecommunication towers, or cathodic pipeline protection. About 50 of these units have been sold worldwide for $12,500 each.

2.5 kW Minotaur
Source: Marathon Engine Systems

Marathon is developing a third, more versatile product called the PowerHouse. Like the ecopower unit, this system produces 5 kW of inverter quality power by using a special generator tied to a battery pack and inverter. An optional second engine in the same enclosure can raise the output to 10 kW. The base PowerHouse unit costs $15,000 plus an additional $1,000 if CHP thermal recovery is desired.

Another PowerHouse option adds batteries sized to the site load. The batteries can operate for 12 hours or longer before the engine needs to run. Thus, the engine functions as both a generator and battery charger. This unit—costing $25,000—provides electric power and thermal energy for remote high-end residences and small commercial applications. The battery bank option for remote applications allows the unit to potentially benefit from the once-a-year scheduled maintenance interval described earlier and to have as much as nine years of site time before an overhaul. An overhaul kit at the end of the nine years consists of a field replacement engine that costs $900 and requires only four hours of on-site labor.

5 kW PowerHouse

Marathon believes that the U.S. market will grow substantially because of energy security and CHP efficiency benefits. Ecopower units provide backup in the case of grid failures, such as from ice storms and hurricanes, since the units can be fueled by natural gas or from on-site propane tanks. Cocking says the PowerHouse units could help co-ops facing difficult or expensive line extensions.

McClelland says that in the near term, Marathon units look promising for edge-of-the-grid applications and backup residential generation. "The Marathon is a potentially attractive, cost-effective alternative to the residential fuel cell," says McClelland.

He offered the following example: A propane-operated fuel cell might have an electric generation efficiency of 35% compared to the Marathon engine's efficiency of 25%, but that is not the full story.

A typical co-op residential customer uses around 900 kWh per month (when the water heating is provided by the Marathon's or fuel cell's thermal recovery system). At this level of electric use, a fuel cell would use 95 gallons of propane a month; the Marathon engine, 133 gallons a month.

(Thermal recovery from either the Marathon or fuel cell system would offset some of the fuel cost. Additional compensation is that the 165 °F thermal recovery temperature of the engine system is better suited to space heating since it is warmer than what a PEM residential fuel cell provides.) In any event, at $1.30 per gallon for propane, the extra fuel cost to operate the Marathon engine would be $600 more a year than it would be for a fuel cell.

"However, a Marathon PowerHouse unit with batteries could be expected to last more than 9 years before needing an overhaul," McClelland notes. Assuming equal maintenance costs and given a 7% cost of money, the present-worth life cycle cost of the extra propane for a Marathon system for nine years would be $4,000 more than for a fuel cell.

"Consequently, the Marathon is a better value as long as its purchase price is at least $4,000 less than a comparable fuel cell," he says. This means that the purchase price of a residential fuel cell would have be under $17,000 to economically compete against a Marathon ecopower unit.

Finally, he adds, the engine system is simpler, just as quiet, and does not need special grade propane like a fuel cell. "Marathon systems clearly merit attention by co-ops with line extension, edge-of-the-grid, backup, or remote residence needs."

Model:	ecopower	Minotaur 2500
Application	Residential or Small Commercial: Grid Parallel Distributed Generation and/or Grid Independent incl Backup. Potential add-on to Solar or Wind systems.	Remote: Grid independent or Backup power residences, agricultural telecommunications, cathodic pipeline protection, etc.
Price	$12,500 to $13,000 for 4.7 kW system depending on whether external radiator is added. 5 kW Base System $12,500 Options: Add radiator $500	$12,500 to $15,500 for 2.5 kW system depending on whether LoNoise and Cold Weather package are added. CHP adds $1,000; 5kW unit adds $500. 2.5 kW Base System $12,500 Options: Add ColdWP* $ 2,500 Add LoNoise $ 500 Add CHP $ 1,000 5kW Capacity $ 500 *Optional cold weather package for below 20°F
Electric Generator Type	Marathon special engine and permanent magnet generator tied to inverter power output.	Marathon special engine and permanent magnet generator tied to inverter power output.
Electrical	4.7 kW Grid Parallel with Grid Independent Backup Mode 120/240 VAC Blackstart battery Inverter Quality Power	2.5 kW (Option of 5 kW) Grid Independent Only 110/240 VAC or 48-100 VDC Blackstart battery Rotary Generator Power Quality
CHP (Thermal Recovery)	Included: 22,500 to 47,000 Btu/hr	Optional
Noise Level	<56 dB at 1 meter	65 dB at 7 meters w/o LoNoise silencer kit
Fuel and Efficiency	Propane or Natural Gas: ~25% HHV electrical generation efficiency	Propane or Natural Gas: ~25% HHV electrical generation efficiency
Control Methods	Thermal load following or Electrical load following or Clock/ Remote dispatch (with optional external fan radiator)	Electrical load following or Clock/ Remote control.
Other	30”W x 54”L x 43”H 900 pounds Indoor or Outdoor UL-type Approval underway for U.S. 700 Grid Parallel units operating in Europe 5 GP/GI Demo units in U.S.	41”W x 41”L x 35”H 525 pounds Outdoor UL-type Approval underway for U.S 50 Grid Independent units operating worldwide.

5.0 SUCCESSFUL MASS DEPLOYMENT

To meet the targets of conservation and generation capacity this strategy is the most compelling one to reduce demand and increase capacity with small grid infrastructure costs.

In order to get its deployment to the significant levels required, immediate and aggressive action must be taken to raise public awareness and acceptance, develop an installation and service levels to meet the need and arrange acceptable consumer and utility financing to pay for the deployments.

The Home Energy Makeover Program provides a first step to accomplishing these goals. Every community should have a home, which shows how the systems provide lower costs, and improved comfort levels.

Every home possible should have an action plan to deploy all the measures so that they can deploy as soon as possible or as soon as the price of energy helps them make that decision. Through the assessment of each applicant for the program this plan can be delivered.

On the utility bill, financing is a key component as demonstrated by Delta Montrose Electric Association (DMEA} in their ground source heat pump program. This financing can be provided by conventional lenders but labeled or put on the monthly electric or gas bill so that the consumer knows that this is a utility program.

6.0 Conclusions

The CDM potential for delivering the significant portion of our current and future energy needs is real and attainable, cost effectively. The obstacles to mass deployment are surmountable by not relying on conventional process but by professional action.

The OPA is uniquely positioned to deliver the programs and expertise needed to achieve the energy goals in the allotted time frames but has to take aggressive action to be successful.

High Efficiency Transformers can Prevent Pollution Improve Power Quality and Save Money

By John Shamess, International Innovative Systems

Across the country, coal is the most common source of energy used for the generation of electrical power. It is assumed that the power will always be available at the receptacle to use. Regrettably, when considering the first-cost savings during the purchase of transformers, most buyers do not take into account the 25-year commitment to substantial losses, which require the unnecessary burning of millions of tons of coal. This translates into:

- The lifetime operating expenses that will dwarf the first-cost savings of the transformer.
- Increased greenhouse gases and smog; and the power sources required to feed these losses during the peak periods of the hottest, smoggiest days.
- Poor power quality: the average transformer distorts electrical power as the loads become increasingly electronic (non-linear). The rapid spread of sensitive electronics in everyday products increases distortion, causing lower reliability, lost productivity and higher transformer losses.

E-Factor transformers are different. They are optimized to feed everything from high concentrations of electronic equipment to simple light bulbs. E-Factor transformers reduce losses up to 74% (on average by over 50%), producing substantial energy savings. Improved power quality to connected equipment such as sensitive electronics (i.e. computers) bolsters productivity.

THE OPPORTUNITY

There are over 4 million commercial buildings in North America. 70% built before 1980 and 50% before 1970. Assuming an average of 6 to 10 transformers per building, there are approximately 24-40 million dry-type transformers that are close to the end of their life. Therefore, over the next few years, a huge number of transformers will be replaced. This is a golden opportunity to ensure substantial saving, as well as lowering losses, pollution and greenhouse gas emissions for the next 25 years.

Imagine cutting transformer losses in half. Dozens of power plants could be shut down or used to supplement existing capacity. The air would be cleaner, and hundreds of millions of dollars would be saved. The race is on to produce "green" power using solar, wind, and fuel cells. However, more efficient consumption of power is ultimately “greener”.

The big hurdle is overcoming the temptation to save on the first-cost purchase of transformers. Unlike utility grade transformers, the specification and purchase of commercial and industrial transformers are less focused on the lifetime losses. Most purchasers have no idea that the cost to pay for the losses incurred by the transformer is many multiples of the first-time cost (see the life cycle cost comparison below). E-Factor has prepared an energy savings and payback calculator that compares the operating cost with the first-cost. This demonstrates the benefits of using E-Factor transformers versus the low-cost/low efficiency products.

Education is part of the Solution. The EPA Energy Star program, a labeling program that recognizes products that reduce energy consumption, now incorporates the commercial and industrial transformer. E-Factor transformers are Energy Star compliant and much more.

The Energy Star program has raised the profile of the transformer as a source of losses, but it could go further. The program references a test protocol that does not reflect the real world losses associated with the high percentage of today's electronic loading. Therefore, the test fails to consider as much as half the actual losses incurred. Since the test uses linear loads, it exempts a transformer from having to meet its efficiency targets when feeding non-linear loads. E-Factor transformers are optimized for, and tested under, electronic loads to reflect real world performance. Loss reduction of 50% is common and documented with this design of transformer.

Living Environment vs. Equipment Operating Environment

The traditional focus is typically on losses, the associated dollars, and the impact on our external environment (pollution, etc), which is something we can all easily relate to. But the average purchaser is not aware of power quality issues and the high cost of powering electronic equipment with standard transformers. A distorted supply voltage will reduce the operational reliability of equipment and cause premature failure. By optimizing the design for this sensitive equipment, E-Factor is able to reduce distortion and increase operating efficiency. Customers have documented the impact of cleaning up the voltage waveform to their equipment. They identify savings in areas of productivity and reliability that are many times the energy savings. So just because the power quality gains are less "tangible" than energy savings, it would be a mistake to leave them unaddressed.

Conclusion

There is often a tension between doing the best thing for the environment and the cost of implementing the changes. In this case the choice is simple. Replacing a standard transformer with a E-Factor transformer delivers both environmental and productivity improvements while saving money. The payback can be calculated, demonstrated and very attractive.

Many E-Factor transformers are already installed. There are millions to go. An old tag line for the Energy Star program is right "Saving the Earth, Saving your Money". Let's get on with it.

E-Factor transformers are Canadian made. www.e-factor.ca

Please consider the following:

- all forms of clean energy, including clean coal, coal gasification and nuclear should be part of the provinces energy mix so Ontario isn't
overly dependent on any one energy source and vulnerable to dramatic price increases of a single energy source.
- Ontario should be self sufficient for electricity supply. Affordable, reliable power for the Ontario public.
- Environment is an issue but we should not do the ridiculous. Include gas in the mix, if economically viable, but keep the coal fired generators for summer and winter peak periods. Smart meters are not the answer for peaking.

Thank you, Rhys.

As a resident of Ontario, I would like to offer these thoughts on electricity mix and supply in this province that would take us into the next century.

* Continue with the refurbishment of our provincial nuclear assets with possible new development over the next 20 years
* Utilize our current Coal Generating assets by upgrading all existing units with scrubber and selective catalytic reduction technology (Coal will always be the most cost effective fossil fuel currently available and capable of producing near zero emissions with available technology)
* Maintain and expand on Hydraulic generation were possible
* Invest in coal gasification generation and possible conversion of current facilities to this form of combustion fuels
* Invest in minimal gas fired generation and only used during peaking demand times (This would still be more cost effective than purchasing power from outside the province!)
* Remain cost competitive with other suppliers and keep electrical generation publicly owned by the province of Ontario
* Continue educating the people of Ontario in regards to energy conservation. The use of Smart Meters will not achieve the desired effects intended and add to household debt especially for those on fixed incomes.

The people and industry of this province deserve an affordable, reliable and self sufficient electrical system to continue growing!

Thank you for your time.
Kevin Jones

Dear Sirs,

Removing governmental barriers for small or micro power generators to become part of the system, as well as providing economic incentives for micro power generation would seem to me to provide a low-cost, low-maintenance way to meet future power needs. Right now the barriers for individuals to construct wind generators to power their own homes or businesses is very costly and to make it worse, there are serious barriers to joining the power grid to contribute.

Addressing these two problems would, in my opinion, provide Ontario with a highly stable and efficient system that would meet long-term needs.

Sincerely,

Corey Jubenville

For the health of our bodies, our cities, our country and our economy, please include a strong conservation and renewable power scenario with a minimum of 60% renewable electricity by 2020 and a full phase-out of dirty coal and unreliable nuclear power in your upcoming recommendations to the Minister of Energy.
JJ Hunt

"I arise in the morning torn between a desire to improve the world and a desire to enjoy the world. This makes it hard to plan the day."

- E.B. White

Written Submission on Ontario Supply Mix

This text is based on the three years activity at the University of Toronto
Stan Pejovic, Bryan Karney, Andrew Colombo and Stan Pejovic's 15-year work

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1.1 Optimisation of the Electrical System

The economy of power plant design implies that units' maximum efficiency is at lower outputs then the so-called rated one, which is the maximum output as well. If the system is optimized to produce at the lowest price, the difference between the generating power and maximum (rated) power (some generators 10% overloaded) of all units in operation will be an essentially free spinning reserve which will stabilize the system (market) and the production costs will not only be reduced, but will be less variable and the system as a whole will be protected from blackouts. The two most important goals achieved are: (i) free spinning reserve, and (ii) the best price of electricity (cheapest electricity production $/kWh). Such an environment will help the whole economy to flourish. As of today, investments should be directed to this achievable goal. Again the Ontario Power Authority, the Ontario Energy Board, Ontario Power Generation, the universities, investors, manufacturers and designers must act together to develop the proper generation mix, upgrade the transmission and distribution system and reaffirm Ontario's (Canada's) Kyoto commitment. The crippling effect of an undefined market and investment uncertainty must be clarified and solved, or erratic prices will continue and the effective control of the whole system could be forfeited[2].

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[1] (Copy from RFP) 1. Provide analytical tools, including modeling tools and data, to be used in implementing a planning approach that focuses on assessment of risks, environmental attributes and cost characteristics of various portfolios. Develop detailed models applicable to Ontario's future demand and supply resource mix, and utilize these models to assess representative scenarios and portfolios that are developed and judged to meet criteria. Provide assessments of Ontario's future supply mix for the period to 2025 (per instructions from the Minister, noted above) using these tools and data. Provide assessments also of resource scenarios and portfolios developed in components 2, 3 and 4 (below) of this RFP.

This stage of planning requires speed and flexibility in assessments rather than detailed models. The OPA will value a focus on assessment of risks that could affect portfolio performance, including financial, market, environmental and other quantifiable and qualitative risks. A framework to assess the exposure to these risks and mitigation measures to reduce such exposure is required.

The chosen consultant (the "Consultant") will work closely with OPA personnel during the execution of this work and recognize the OPA's additional objective of transferring technical capability and knowledge to such personnel.

The Consultant shall commence work on the planning framework and risk assessment immediately upon signing of the contract and provide ongoing analysis and iterative portfolio assessment prior to and following receipt of the deliverables under component 2, 3 and 4. Final portfolio analysis is to be completed by the Consultant by October 31, 2005.

[2] Enclosed to Submission 1:
Attachment 1: Short description: Electric Generators Profit/Costs On-Line Management and Control < Pejovic Karney Turbine Online Management Short Description.doc>

1.2 Supply Mix

Wind can supply only a small fraction of the needed electricity supply. There is often no wind during summer hot spells and winter cold snaps but these are times of high electricity demand. Consequently, even when wind-generating equipment is installed, it must be buttressed by other sources at those times when consumption is the greatest and the wind supply is insufficient. Solar power is also a popular concept, but it is expensive and available less than a third of the time. Therefore, it is also only capable of supplying a small part of future requirements. Overall, solar and wind energy as well as conservation, cannot solve the electricity generation shortfall; they cannot replace aging coal-fired and nuclear base-load generation over the coming years. Given justified concern air pollution, there are two realistic alternatives, namely more gas-fuelled generation or more nuclear generation, but the best solution is to combine them with pumped storage plants in order to compensate for about 50% of their pollution burden and to proportionally curtail the risk and amount of nuclear waste. (Please see Chapter *Pump-Storage Plants to Replace 50 % of Thermal Plants*)

Natural gas pollutes the atmosphere less than coal, but can still not be considered a clean energy source. Current policies and proposals lean more heavily on gas, a diminishing resource whose cost and reliability is questionable. Storage plants are again part of the best solution.

Nuclear power production combined with pumped-storage plants is relatively non-polluting, has controllable optimal operating costs, and has almost unlimited fuel sources. Environmentalists should consider supporting nuclear and storage power plants as a possible realistic alternative to greenhouse gas problems caused by burning fossil fuels.

Hydrogen is the important candidate for replacing gasoline. Various institutions are studying technologies for generating hydrogen in large-scale amount. High natural gas price is pushing industries to steak alternative sources of hydrogen.

Ontario needs a variety of approaches, ranging from wind and solar power, to conservation initiatives that are economically achievable. Moreover, there may be a need for some new gas-fuelled generation for peak load purposes. But unless nuclear and pump storage form the central part of the generating capacity for base and peak loads, the deficit in energy generation linked to cleaner energy is unlikely to be solved. Something similar has already been stated publicly, but pumped-storage power plants should be highlighted as the best economically achievable generation for peak and storage energy.

1.3 Stability and Spinning No-Load: Two Free Benefits from Optimizing an Electrical System

There is one economic and physical challenge that deserves particular attention: For an electrical system to be stable, and thus to avoid blackouts if there is a sudden shift in load conditions, it is essential that there are plants in operation in the system that are "spinning" but with no-load, or some plants running at partial loads. Such plants are not actually producing electricity but their rotating generators are still electrically connected to the grid. Such an operation allows the system to quickly respond to changing conditions, and thus to match power production to energy demands. (Great Britain has two pumped-storage plans operating at partial loads and speed no load mode and they have protected the system from blackouts and frequency variation; they are: Dinorwig, 6x330 MW ≈ 2000 MW and Ffestiniog – 4x90 MW ≈ 360 MW)

Simultaneously, the economy of designing power plants implies that unit maximal efficiency is at lower output level then the so-called design or rated levels for these units and short time over load as well. This situation creates a wonderful way of both achieving higher efficiencies and providing a free spinning reserved. Specifically, if the system optimized to produce power at the lowest price, the difference between the generating power and maximal, rated power of all units in operation serves essentially as a free spinning reserve. Moreover, this same capacity will serve to stabilize the system (market), with the benefits that the price of power will be more uniform and that the system as a whole will be protected from blackouts. Thus, an overall approach for optimizing the system will allow two important goals to be achieved: (i) free spinning reserve, and (ii) the best price of electricity (leading to the cheapest price per kW or to maximal profit).

1.4 Electricity Production at Best Efficiency Incorporate Free Spinning Reserve and Stability

A key issue in providing a reliable and affordable electricity system is that of the price of energy consumed and a reasonable variation in this cost. Yet, without explicit consideration of production and spinning reserves in power generation, we contend that stability cannot be achieved, and the instability will inevitably create huge economic and social consequences. Although the 2003 blackout was imported from the US through the south transmission line, the provincial blackout occurred because Ontario had insufficient running power and weak connections with the provinces; thus, overall, the province had insufficient reserve capacity to stabilize the system after a sudden and unexpected loss of the power from South.

The demand for power and generation is not uniform in time, and the variable nature in the requirements for energy and its production need to specifically be built into the system if stable and affordable power is to be produced. The minimal spinning reserve and stand-by reserve available must be equal to uncontrolled removal of the biggest generator or biggest power plant, or the power transmitted by an uncertain transmission line, whichever is greater. Principle for running a system, often called the "n-1" criterion (the US criterion), is based on

the premise that no single event (such as the loss of a line or a generator or an electric plant) should lead to the cascading uncontrolled failure of a large portion of the system. .

Reversible Pump-Turbine Storage Plants are often the best solution for peak power generation, providing "spinning no load" reserve, stand-by reserve, and achieving a low price per unit produced (kWh) and per unit installed (kW capacity). Droughts do not endanger supply as pumped-turbine storage electric plants do not suffer this limitation and thus overcome this shortage. Despite the long-term promise of other technologies, pumped storage systems remain the only economical way to "store" large amounts of clean electricity. When combined in production with thermal pollutant and nuclear power plants, pumped storage plants can reduce contamination from power production by 50%, while at the same time minimizing power production costs (dollars per kWh). New variable speed hydraulic machines operates all the time at the best efficiency and highly reduced vibrations, decrease operating and maintenance cost for even 50 % or more if appropriately managed by experts; total efficacy off the plant is increased up to 85%; in other words electrical energy pumped into the storage at off peak hours generates into the grid up to 85% as expensive peak energy.

Finally, the only generators which could deliver electric energy at the price below 5 cents per kWh are nuclear, hydro and coal fired power plants, but only if combined with pumped-storage plants and powerful long distance transition lines connecting provinces into a strong system. Variable speed pump-turbines are the best units to deliver spinning and speed no load reserve, optimize energy generation and minimize operating and maintenance cost of big nuclear and thermal generators. Designed and operated by experts, generators can deliver electricity at the prise below 4 cents per kWh.

1.5 Electricity Market

The market challenge is to bear the costs for those plants, which are required to operate only few hundred hours per year, or maybe never. Unfortunately, under the current power production regime these standby or speed-no-load units must exist! How to make the system economical and profitable in the competitive market, in which each plant and unit is fighting to make money is a key question. Privately owned companies will invest only if they perceive that their investment will be returned in a short time. Consequently, in the current free market paradigm, the cost of the previously described inefficiency is transferred to the consumer and is expressed in terms of high electricity prices. IESO (New name: Independent Electricity System Operator – IESO; old name Independent Electricity Market - IMO) pricing of energy production should properly finance generators. Standby, speed-no-load units and peak power plants must be paid for in a different manner than the continuously running units and other frequently operated generators. Peak power plants are stabilizing the electricity grid and safeguarding against blackouts which, when they take place, are extremely expensive. The chapter entitled *Optimisation of the Electrical System* demonstrates the possibility of achieving a free spinning reserve and at the same time the most economical generation of power. This possibility is one of the most remarkable cases of free power and reduced pollution available anywhere!

Most of the investments into big power plants are long-term and therefore private investors will be dissuaded from locking their money for the extended waiting time (10 or 20 years) necessary in order to realize a profit. This problem has not yet been removed, but if not solved immediately, the energy crisis will continue and worsen. Consequences have included blackouts with their painful repercussions for industries dependant on the price of energy.

2 Add 2[3] (CDM ("Conservation and Demand Management") options and associated risks. Based on credible recent publications and source from industry organizations, research and public agencies and developers, included in the long-term supply mix plans, achievable potential, costs, implementation barriers, sector specific characteristics, experience.)

2.1 Demand Side Management

The Ontario Government pursues DSM (Demand Side Management) more than new generation opportunities. Implementation can be fairly straightforward and can be followed up at the commercial and residential levels. With time-of-use electric metering and substitution of electric resistance heating (e.g. baseboard heaters, water heaters, clothes dryers, etc.), energy savings, particularly during peak periods, can be achieved on the order of 5% of our total electrical demand. Achieving a 10% saving on peak power will be much harder and anything beyond that would require a complete transformation of the way we use electricity. One thing is certain, the more electricity costs, the more incentive there will be to save. Also DSM will clearly not help in alleviating the long-term rehabilitation requirement of our generation equipment in Ontario.

2.2 Renewables – Solar, Biomass and Wind

The greatest difficulty in implementing such systems in Southern Ontario was that we did not have enough sunny days. In remote areas in Northern Ontario, solar power can only provide limited amounts of local energy production. Therefore, its impact has been negligible on the overall power generating capacity of Ontario.

Significant amounts of wood waste are available throughout Ontario, mostly from sawmills. A few of the larger sources have already been developed for power generation and are

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[3] (Copy from RFP) 2. Provide a comprehensive assessment of different CDM ("Conservation and Demand Management") options and associated risks. This requirement is to be based on credible recent publications and source information from industry organizations, research and public agencies and developers. Develop CDM portfolios to be included in the long-term supply mix plans. These portfolios must be applicable to Ontario over the period to 2025 (per instructions from the Minister, noted above), and be based on credible estimates of technical and achievable potential, costs, implementation barriers, sector specific characteristics, experience in implementation of CDM, and technology developments. Assumptions regarding current and prospective government policy support of CDM must be explicit, especially where there are assumptions with respect to additional measures required of government, the OPA or other industry actors and consumers in advancing CDM measures.

The Consultant shall present its draft analysis to OPA personnel who will subject this analysis to critical assessment. The Consultant shall finalize its analysis following this assessment.

The Consultant shall deliver the underlying draft analysis by August 26, 2005 and the final deliverable by September 16, 2005.

financially viable, provided the discarded wood is available at no cost. The biggest problem with wood waste plants is that plant capital costs become excessive below an output capacity of around 10 MW (due to economics of scale) and transporting wood waste for more than 150 km is usually too costly and becomes energy intensive in its own right. Having said this, there are several wood waste projects under consideration and this energy source can provide several hundred MW of relatively "green power."

Another good source of energy is biogas from sewage treatment plants and landfill sites. Biogas can be used to fuel reciprocating engines down to several hundred kW in size and are relatively simple and "inexpensive" to build."

Wind power is probably the best-known renewable energy source under consideration. Although the technology to build windmills has evolved significantly, wind power plants are still relatively costly. Also, wind power is not deemed to be firm capacity. They have to be backed up by conventional generation plants, and can best be viewed as a fuel saving opportunity for fossil fuel plants. Having said this, wind power is capable of providing over 1000 MW of electrical power here in Ontario, and it thus can play a role in achieving an overall solution. More importantly, wind's effectiveness increases greatly when used in conjunction with a pumped storage scheme and hydrogen production; in this case, power can be produced whenever wind is available, and the energy consumed whenever the energy is required, and not simply when the wind blows. All investments should be balanced, or at least carefully re-evaluated, and the money saved put into basic and peak generators.

2.3 Deep Lake Water Cooling Project cools Toronto

Toronto has developed an alternative cooling system, which uses the cool energy in cold water (4^0 Celsius) to air condition high-rise buildings in downtown Toronto. This innovative system is great for the environment. It reduces energy consumption, and so reduces carbon dioxide emissions. Toronto now serves as a model for other urban centres looking to reduce their energy use, save money and make a positive impact on the environment.

3 Add 3[4] (Supply technologies and resources and associated risks. Capital and operating costs, performance characteristics, technology life-cycle, environmental impacts and any other relevant characteristics. New natural gas generation, coal gasification (with and without CO_2 sequestration), nuclear (new and refurbished) and, based on Ministry of Natural Resources (Ontario) data and inventory, wind, biomass and hydro-electric resources.)

3.1 Introduction

The specific goal is to provide additional background and context for the specific suggestions. We strongly feel that what might appear to be relatively minor changes at this stage will entail a long-term and highly positive benefit for the production of an efficient, economical, renewable, reliable, sustainable, and stable power production system in the Province of Ontario. In fact, a full and comprehensive approach to the optimization of the electrical system offers the potential of realizing two significant goals: obtaining an essentially free spinning reserve and simultaneously achieving the most economical generation. By contrast, repeating the blackout experiences of the past may cost as much as 2 to 4 billion dollars per event.

3.2 Profit On-Line Management and Control

The method and software are designed to increase profit, to protect a unit from accidents and incidents, to instruct the plant and system technical and management staff what to do when selecting the most profitable operating points of generators, plants and the system as a whole generator of electricity to Ontario. Any trouble announces itself in time. We have only to recognize it on time, in advance[5].

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[4] (Copy from RFP) 3. Provide a comprehensive assessment of different supply technologies and resources and associated risks. This requirement is to be based on credible recent publications and source information from industry organizations, research and public agencies and developers. The assessment will include identification of capital and operating costs, performance characteristics, technology life-cycle, environmental impacts and any other relevant characteristics. The assessment will present data suitable forplanning studies on a consistent basis for the following supply technologies and resources in the Ontario setting: new natural gas generation, coal gasification (with and without CO2 sequestration), nuclear (new and refurbished) and, based on Ministry of Natural Resources (Ontario) data and inventory, wind, biomass and hydro-electric resources.

The Consultant shall present its draft analysis to OPA personnel who would subject this analysis to critical assessment. The analysis would be finalized following this assessment.

The Consultant shall deliver the underlying draft analysis by August 26, 2005 and final deliverable by September 16, 2005.

[5] Enclosed to Submission 1:
Attachment 1: Short description: Electric Generators Profit/Costs On-Line Management and Control < Pejovic Karney Turbine Online Management Short Description.doc>
Attachment 2: Case, Descriptions of hydroelectric plant optimisation: Hydroelectric Generators Profit/Costs On-Line Management and Control < Pejovic Karney Hydroelectric Generators Profit.doc>

Vibrations are very important, and must be analysed and considered on-line all the time. When measured vibrations are close to the limits, operation is only permitted under particularly monitoring and supervision; if the limit is exceeded incident should be expected; the units must be repaired to prevent accident.

Generators, Powerplants and System Profit On-Line Management and Control custom designed software increase profit, select the most profitable operating points of powerplants and (Ontario) system. By selecting the best exposure rate the profitability and reliability of powerplants and related subsystems can be increased. On-Line Management and Control software is the monitoring and control computer system, which increase profit and energy production level.

Selection of input data is based on Standards, Guidelines, Model Tests, Site Tests and Technical Literature. By means of statistical analysis of measured and recorded data, the efficiency of the On-Line Management and Control software could be improved.

Energy production costs are dependent mostly on vibration intensity and related exposure rate, which is increasing continuously in time. Exposure rate as correlation between the real time and reference time of operation is the most important characteristic of the unit. It is a statistical data. Some standards, guidelines and technical papers consider vibration and correlate it to the exposure rate. The on-line measured data compared to the data measured several hundred hours ago are changing in time. They are highly influenced by real time of operation and exposure rate, and operating point. Vibrations (amplitudes and corresponding frequencies), and other machine characteristics have a strong influence on numerical values of exposure rate. Statistics are based on the data from technical literature and should be and could be improved for any power plant analyzing files of measured and logged records, which will improve numerical on-line measured and calculated values[6].

3.3 Coal Fired Generation

Although authorities would not imperil the electricity supply by shutting down coal-fired plants before replacement capacity is available, depletion of fossil fuels will do that soon enough. Until such time, a reasonable approach would be to upgrade the environmental emission controls by installing the appropriate air pollution control devices, and run these plants to the end of their life. At 36% thermal efficiency for these plants, conversion to natural gas would be completely uneconomical. The money would be better spent on hydrogen, hydroelectric, pumped storage, gas-fired peakers (i.e., plants specifically designed to meet peak load requirements) and transmission lines to connect the Ontario grid not only to the US but to neighbouring provinces as well. At the same time, pumped storage plants encourage lower maintenance costs for thermal plants.

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[6] Enclosed to Submission 1:
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Attachment 2: Case, Descriptions of hydroelectric plant optimisation: Hydroelectric Generators Profit/Costs On-Line Management and Control < Pejovic Karney Hydroelectric Generators Profit.doc>

3.4 Gas Fired Generation

With natural gas prices tripling over the past five years, its use as a fuel for power generation has to be carefully scrutinized. Peakers may be attractive for dealing with daily load conditions, especially during the summer. They would only have to run for approximately 1000 to 2000 hours per year. Merchant class combined cycle plants with no steam host may be difficult to develop. It is unlikely developers would carry the fuel risk for such a project.

3.5 Hydro Electric

Surprising, as it may seem, hydroelectric power has significant untapped potential in Ontario as the only cheap renewable and peak energy. Yet if this potential is to be properly and fully realized, one of the most pressing requirements is again to establish a reasonable and stable economic climate that will effectively reward and encourage suitable energy investments. This problem is itself challenging, but is a prerequisite to all other development. Bruno Trouille has recently published an excellent, reflective and well-written article on this topic ("The Need for a New Approach to Hydropower Financing," *HRW*, March 2004, 22-29)[7].

Once a suitable economic climate has been created, hydro investment can be pursued in three primary ways:

a. First, there is considerable opportunity to develop new power plants, particularly of small to medium size, without significant environmental or economic problems being encountered. These are particularly attractive in sites where most of the other power production infrastructure is already in place (dams in particular).
b. There is a significant opportunity in some cases to retrofit existing hydro facilities by replacing older or less efficient turbines with newer and more efficient units. Moreover, since hydro can play a decisive role as a peak provider, in some cases smaller plants can be expanded, and new larger units added (probably technically better solutions), with the goal of meeting short-term peak loads more effectively while at the same time not increasing the total amount of water passing through the plant on a longer duration basis.
c. Probably most important, there is tremendous potential and need in Ontario to create pump storage plants. These can store energy, a capability that is uniquely and efficiently available only in large-scale facilities of this type.

Significant advantages could accrue from the development and use of pumped storage. One advantage that a pumped storage facility creates is the ability to run other energy production facilities far closer to their optimum points, thus saving power and reducing environmental costs. The approach is simply to save energy in the form of water elevation during periods of low electrical demand (increasing efficiency of the system), and to release this water to supplement peak production during period of maximum demand. This single capability would have an enormously positive impact on energy reliability, on the environmental burden of energy production, and on the economics of meeting energy demands. It should be noted that

[7] Please see also our presentations no 17th November 2004 and 3rd March 2005.

pumped storage plants play a critical role in the operation and stability of many countries (including Great Britain, Germany, France, Italy, Luxemburg, US, Japan, Russia, China, Taiwan). Ontario has fallen behind in the exploitation of this crucial resource for ensuring energy supply stability and reliability[8].

3.6 Reversible Pump-Turbine Storage - a Solution to Peak Power Generation

Peak electricity demand has been satisfied mostly with fossil fuel generation. Coal prices have increased 60 to 65% over the past couple of years while petroleum and derivative prices have surged by 60% or more in one year; it has been rapidly increased (US$13 in 1998; US$65 in 2005 per barrel). Natural gas-fired generation has long been considered as the method of choice to augment the electricity supply in this province, but prices for natural gas have tripled in less than five years and its long-term supply is by no means secure. The Alberta Reserves Report recently stated: "Conventional natural gas production in Alberta likely peaked three years ago, and a yearly decline of about 2.5% should be expected."

The substantial growth in input prices will work its way into consumer electricity prices as coal and oil reserves expire. While the core Consumer Price Index (CPI) is estimated at 2 to 2.5%, this figure excludes energy prices. Nonetheless, ratepayers do not have a similar opportunity to exclude them from their bills. Energy inflation is currently in the high single digits per year and climbing.

Clearly something must be done!

Hydro power plants, as well as reversible pumped-turbine storage electric plants, are a better solution than any other system to meet peak energy demand: they respond faster and are the only ones producing or taking advantage of clean energy. Furthermore, they typically enjoy a lengthy service life (sometime up to a hundred years or more) and they are very efficient. The heavy reliance on hydroelectric power in many countries of Central and South America has become a burden, because drought has endangered the reliable supply of electricity; reversible pumped-turbine storage electric plants are far less vulnerable to protracted dry spells.

In Ontario and some countries, which do not have plants with large reservoirs, reversible pump-turbine storage electric plants reduce production costs for the system. Ontario does not have reversible plants that could accumulate low-cost energy (deriving from wind and solar sources or when thermal plants operate below the technical *minimum*) by pumping water into storage reservoirs when there is a surplus of generating capacity and then releasing it when needed back through the pump-turbine assembly that would operate in turbine mode.

Hydrogen as a fuel cannot be a cheap and economical storage of electricity as the efficiency of transformation cycle (electricity surplus – hydrogen – electricity peak energy) is at the level of 40%.

[8] Please see also our presentations no 3rd March 2005.

3.7 Pump-Storage Plants to Replace 50 % of Thermal Plants

Two thermal power plants (nuclear and/or fossil fuelled) could be exchanged with one thermal and one pump storage facility, which transfer the energy surplus delivered by the thermal plant into its water storage reservoir. When consumers need more (peak) energy, both the thermal and pump-storage plants would furnish the required electricity. Therefore, the risk of nuclear plant downtime and greenhouse plant emissions (GHG) from fossil power plants could have been reduced by 50%[9].

3.8 Ancillary Pumped Storage Benefits

Additional benefits of pumped storage (and hydroelectric) plants are as follows.

3.8.1 Power Factor

Various Canadian federal, provincial, and U.S. regulations provide financial incentives to electrical generators that can advantageously modify the power factor of the electrical grid. Hydroelectric plants, if designed for this purpose, can use turbine runners to spin in the air and thus increase the power factor; pumped storage plants can always play this beneficial role.

3.8.2 Stand-by Reserve

Some electricity generating plants are held in a 'warm' state that allows them to increase electricity output immediately or on short notice. Since coal-fired power stations take several hours to warm up, some thermal power stations are kept in a condition known as 'spinning reserve'. Pumped storage plants are actually more efficient and do not discard energy while in standby or emit greenhouse gases such as carbon dioxide (CO_2), nitrous oxides (NO_x), sulphur oxides (SO_x), particulate matter, mercury, arsenic, volatile organic compounds (VOC), or other materials that are toxic for the environment and human health. Pumped Storage plants keep turbines “warm” as stand by reserve or rotating reserve with minimal water flow or even without flow (i.e., spinning in the air).

3.8.3 A Complement to Wind and other Renewable Energy Sources

All levels of government are encouraging the development of electricity generation from wind power. Yet wind blows intermittently and erratically. A large fraction of electricity generated from wind and other sporadic sources (such as photovoltaic, solar) cannot be relied upon at any given time. The unpredictable nature of these sources necessitates a greater amount of running and spinning reserve in order to cover situations when these sources may not be generating and/or when demand may transgress expected values. In the UK, a study by the former CEGB (Central Electricity Generating Board) estimated that “additional reserve might be required

[9] Please see also our presentations no 17th November 2004 and 3rd March 2005.

once intermittent sources supplied more than 20% of peak demand in England and Wales."

3.9 Pump-Storage Plants Are All Over the World but Not in Ontario

Ontario (and Canada) are surprising exceptions when it comes to the effective utilization of pumped storage, with many countries enjoying its benefits for years already. Even small nations like Belgium and Luxembourg have more Pumped Storage capacity than we have. We respectfully submit that this does not make sense. Ontario (Canada) is not on the list of "1000 MW and Larger Pumped Hydro Installations Worldwide" but should have been long ago. (Viadnen, 1096 MW in Luxemburg was built in 1964; Lewiston, Niagara 2880 MW built in 1961 has a head of only 33 m – Ontario and Canada have thousands of sites around their lakes and seashores).

For example, there has been much discussion about the proposed Conawapa project in Manitoba. If, as an alternative to this project, or in addition to it, a pumped storage project of similar generating output were built in Ontario, not only would it create thousands of construction jobs and many well paying operational positions, but also it would save Ontario millions of dollars. The magnitude of savings in addition to employment and spin-off benefits would be substantial.

Also, if such a project were located in Ontario it would have the additional benefit of helping to meet Ontario's Kyoto Protocol Greenhouse Gas Emissions target, which would reduce some of the pressures on Ontario industries during the transition.

4 Add 4[10] (Methods to assess the impacts on the natural environment of generation options. Long-term planning, able to capture the cumulative impacts and provide indications of the sustainability of options and supply mix plans. Identification and quantification of relevant environmental factors for assessment.)

4.1 New Developments

The most important task is to establish a multi-tiered pricing system for energy. Electricity from all existing and new generating facilities should be regulated with prices adjusted to reflect the true cost of generation. The Ontario electricity market has to be adopted as the Power Pool in order to assuage investor reluctance to support new power generation infrastructure from any available sources. If this goal cannot be achieved the market should be closed.

The era of fossil fuels is in its twilight with scarcity growing at an accelerated pace. In ten to maybe fifty or one hundred years, first oil, than natural gas and finally coal will be exhausted. At that time, the only viable energy sources will be renewable and nuclear. We have to rely on known power generators and to invest in new technology while hoping for the discovery of new energy sources (hydrogen, ITER = International Thermonuclear Experimental Reactor) all the while existing exigencies necessitating the construction of new generating facilities. Twenty years of experience in Ontario has proven that failure to build new generation capacity is especially costly. Experts, knowledge and skill have been lost during these two decades of inaction and the continuity of know-how has been interrupted, ensuring a weak transfer of practical and theoretical experience. These trends must be reversed as soon as possible.

4.2 Stability and Spinning No-Load

There is one economic and physical challenge that deserves specific mention. For the system to be stable, and thus to avoid blackouts if there is a sudden shift in load conditions, it is essential that there are plants that are "spinning" but with either no-load or running at partial loads. These facilities are not actually producing electricity but their rotating generators are still electrically connected to the grid. Such an operation allows the system to quickly respond to changing conditions, and thus to match power production to energy demands (Please see the

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[10] (Copy from RFP) 4. Provide methods to assess the impacts on the natural environment of generation options. The methods must be suited to long-term planning, be able to capture the cumulative impacts and provide indications of the sustainability of options and supply mix plans. The methods must provide for identification and quantification of relevant environmental factors for assessment.

The Consultant shall present their draft analysis to OPA personnel who will subject this analysis to critical assessment. The analysis shall be finalized following this assessment.

The Consultant shall deliver the underlying draft analysis by August 26, 2005 and final deliverable by September 16, 2005.

case when Dinorwig (6x300MW) and Ffestiniog (4x90MW) pumped storage plants prevented blackout it the UK on 22nd May 2002 at 17:42. Please see our presentation on March 3, 2005). The economic question that must be resolved, but has not been hitherto addressed in proposals, is who pays for this vital capability and who invests to build these generators?

Stated another way, the challenge is to bear the cost for those plants, which are required to operate only a few hundred hours per year, or possibly not at all. Unfortunately for power production systems, these standby or speed-no-load units must exist! However, how can the system as a whole be made economical and profitable in a competitive market in which each plant and unit is striving to make money? Privately owned companies will invest only if they perceive that their investment will be returned in short time. Consequently, in the current free market, the cost of previously described inefficiencies is transferred to the consumer (and taxpayers) and is expressed in terms of higher electricity prices. Current IESO pricing of energy production does not properly finance generators. Standby, speed-no-load running units, and peak power plants must be paid for in quite a different way than the units operating 24 hours 7 days a week, or indeed any other frequently operating generators. Peak power facilities play a decisive role in stabilising the electricity grid and protecting us from blackouts, which, if or when they take place, are extremely expensive. As mentioned earlier, a fully optimized system offers the potential of simultaneous free spinning reserve and the most economical generators.

4.3 Nuclear Generation

The capability to revitalize nuclear reactors and extend their lives simply must be put in place in Ontario. With the careful overhaul of nuclear plants, we could buy time to plan a proper phase out with alternate energy supplies and decommissioning.

4.4 The Transmission Grid

In terms of energy transmission, there would be a great benefit, in parallel to any other improvements in energy production and storage, to building a high capacity transmission line that connects the various consumers and generators, and provincial grids as well. Such a system could exploit the time differences between provinces to spread peak energy across Canada, thus reducing the reliance of any one region on both peak energy and peak energy prices. Enforcing legislated standards would fall to the provinces collectively to make the problem both technically easier to solve and more economical. In this way, a Canadian energy system could be initiated. To date, Ottawa's action to curb GHG emissions can only be interpreted as a failure. Indeed, emissions are higher than ever. Ottawa could actually produce concrete results by helping pay for a transmission line. A secure national energy grid is certainly in Canada's best interest, both from an economic and a national security standpoint. Currently there are no east-west power lines of any important stature or sizable capacity. In fact, the big provincial power exporters — Manitoba, Quebec and British Columbia — send almost their entire excess power south of the border, not to their Canadian neighbours.

Canadian provincial systems are effectively small northern appendages to the large US transmission grids, but without high capacity Canadian transmission lines, provinces are technically dependent on the larger US system. This is the reason for the instability of the provincial grids. The 2003 blackout was imported from the US into Ontario through the uncertain south transmission line and exacerbated by insufficient running OPG generators and weak connections with the other provinces.

Canada once built railways and the St. Lawrence Seaway, understanding that there were ties of national importance that needed to be established. The next step, no doubt expensive but also crucial and inevitable, is to create significant Canadian grid transmission lines. The sooner the better.

4.5 Education and transfer of knowledge

4.5.1 Multidisciplinary Transfer of Experience and Knowledge

Continuity has been lost. Canada has had more than 100 years of experience in the electricity sector but individual areas have lost valuable experience and knowledge that accrued during this period. Poorly coordinated transfer of practical and theoretical experience appears to be the root cause. The consequences are an unstable market and investment climate, accidents, inefficiency and troubleshooting (of the same problems) which have all shown up regularly in recent years and will continue in the future if appropriate steps are not taken. The organized multidisciplinary transfer of experience is a major task that needs to be undertaken by the universities and electricity sector in Ontario; so it is urgent that decisions be made (or perhaps should have already been made). There is a clear need to plan, finance and implement some long-term initiatives.

The greatest task facing the electricity sector in Ontario is the design of new generators and the rehabilitation of nearly all existing units within a short time frame, yet there are too few experienced experts (engineers) and project managers who know how to cultivate the right skills from the market place.

4.5.2 Requirements for New Graduates

New graduates, particularly Masters or PhD recipients, should be able to manage or lead a team and should have 10 to 15 years of design and site experience as well as being able to select and read journals and textbooks. In addition, if there is no the expert to instruct, as it is now in Ontario for some specialities, learning time should be increased in order to ensure adequate competence and reduce the number of accidents and errors. Education costs millions of dollars but serious accidents can cost billions, possibly endangering lives.

4.5.3 Technical Perspective - Two Decades of Inaction

No substantial new generation capacity has been added to the province's supply over the past 20 years. Meanwhile, demand for electricity has continued to grow at 1-2% per annum (approximately 25% in total over that period). Ontario has continued to see its reserve margin shrink from 25-30% in the 1970s to 5% or less today. Also, there is a commitment to dismantle coal-fired generating stations (representing 7,500 MW or 30% of the theoretical total supply), and a number of nuclear reactors are off-line and in need of extremely expensive refurbishing or replacement. Never has there been such a pressing need for new generating capacity and particularly for "peakers" to handle the largest electrical loads.

New capacity is an ongoing necessity. Twenty years of experience in Ontario has illustrated that one of the most expensive strategies is to not build new power plants in a timely manner. New gas and oil fuelled generators are only a temporary solution which deliver expensive semi-clean energy, but long term solutions for low cost energy production can only be achieved by simultaneously combining pumped storage plants with nuclear and coal fired generators. Wind and solar units deliver relatively expensive energy that only slightly substitutes for dirty energy production that is ultimately backed by other power plants.

In summary, pumped storage is an opportunity that has been overlooked at a substantial cost to the environment and economy. Ontario can take advantage of this enticing opportunity to achieve an efficient, reliable and stable power system and set the stage for exploiting the advantages offered by renewable fuels.

5 Add 5[11] (Proposals to develop and manage an effective inclusive stakeholder consultation process which demonstrably meets contemporary regulatory and public expectations. The process will provide baseline measurements as well as reusable interactive models for sustained application.)

5.1 Closing Thoughts

The blackout of Aug. 14, 2003 left vast stretches of Ontario without power. Toronto's subway came to a halt, food spoiled in refrigerators, Ontario residences over-heated in the dark, and stores and restaurants closed. The blackout cost the economy of Canada billions of dollars. Although official blame may fall elsewhere, insufficient spinning reserve were the root cause of the blackout. It is clear that this blackout could have been prevented and that immediate actions must be taken to ensure our electric production and distribution system is more reliable. In fact, failure to act will threaten the reliability of the electricity supply, a resource that is critical to the economy, to energy and to national security. If the system had had spinning no load reserve this price spike would not have happened. Even at the highest consumption, available power must be above demand. This means that all units must be ready: some are covering existing demand while the others are on stand-by, ready to cover unpredictable demand surges or equipment malfunctions. In the case where available resources cannot meet demand, power shortages leading to blackouts are the natural outcome. This has already happened. In many less severe cases, mismatches between generating capacity and demand have necessitated the importation of expensive power, sometimes increasing the price per kWh by a factor of 100 (0.02 to 2 $/kWh) and even more. In these situations, more severe instability could have induced blackouts

To bring about a new mix of power generation sources in Ontario and to replace our aging system will take time. Given the amount of nuclear and coal-fired capacity in question, it may take 15 to 20 years to replace about 2/3 of our existing capacity. An evolutionary approach using labour, technologies and capital available here in Ontario is preferred.

Developing professional staff in Ontario with core competency in power generation will also take time (an important task for the universities, OEB, OPA and OPG). It requires a stable business environment where future projects are developed on a predictable basis. Without this in place, good people would move on to industry sectors in other regions, and our efforts here would be plagued by delays and cost overruns, as they are at present. Currently in Ontario, the average age for trades-people is 52. Since 1982 very few people have gone into engineering schools to study power generation. Even nuclear plant know-how is nowadays mostly accessible from specialist staff having served in the US Navy. Some of our best engineering

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[11] (Copy from RFP) 5. Provide proposals to develop and manage an effective inclusive stakeholder consultation process, which demonstrably meets contemporary regulatory and public expectations. The process will provide baseline measurements as well as reusable interactive models for sustained application.

The Consultant shall present its draft analysis to OPA personnel who would subject this analysis to critical assessment. The analysis would be finalized following this assessment.

The Consultant shall deliver a draft program by August 15, 2005, and a final deliverable by September 6th, 2005.

and trades-people have already been drawn to the oil sands megaprojects, where pay scales rival that of OPG (and are based on merit). Ontario and Canada need the highest and best experts.

To undertake a massive revamping of our electricity system will take more than 25 years. We must learn to maintain what we have, upgrade as required, and plan for what we will soon need. The revolutionary approach may work for software and microprocessor development, but it certainly does not work for power generation. The Ontario electricity system has to be reorganized to meet this task.

The planned multidisciplinary transfer of know-how is the assignment facing the electricity sector and universities in Ontario and Canada; therefore pivotal decisions should have already been made.

Ontario and Canadian universities are not teaching students how to design, maintain, end operate electric plants and auxiliary systems of big thermal power plants

5.2 International Thermonuclear Experimental Reactor

Canada pulled out of the project because the costs seem to outweigh the benefits. It is going to be a long time before Nuclear Fusion generates thousands of megawatts. If this is true it should be carefully analysed again why other counties are in this project.

5.3 Hydrogen

Hydrogen is the important candidate for replacing gasoline. Various institutions are studying technologies for generating hydrogen in large-scale amount. High natural gas price is pushing industries to steak alternative sources of hydrogen. Hydrogen as a fuel cannot be a cheap and economical storage of electricity as the efficiency of transformation cycle (electricity surplus – hydrogen – electricity peak energy) is at the level of 40% or even less.

5.4 Nuclear, hydrogen, hydro future

Advanced nuclear reactors ought to be capable of producing electricity for about 4 cents per kWh. The best operational model could be mixed use sending electricity to the grid during peak hour, and making hydrogen and pumping into storage the rest of time. The proper mix of hydrogen and pumped storage to electricity production would be market and cost depending on electricity price and capital costs. Hydrogen will replace gasoline and hydro and storage plant will be spinning reserve to cover peaks and protect system from blackouts. Advanced design, hydrogen as a fuel and storage cycles provide an economical, secure and safe energy future. The combination is an extraordinary green idea. Moreover a robust nuclear-hydro-hydrogen structure can provide a framework for incorporating energy from wind, solar and other diffuse energy sources, which could become more important as their technology improves.

5.5 Gas producing microbes

Microscopic creatures have been discovered produce methane as a by-product. In other words, might microbes be at work in coal seams turning coal into gas. When it will be achievable and for how long should be carefully analysed?

Hello,
My name is Miriam Katz and I'm the president of the Energy Sustainability Community at the University of Toronto as well as an employee at Gale Force Energy Ltd, a wind developer in Toronto.
When you are looking at the future supply mix for Ontario, please consider renewable energy and conservation.
With regards to renewable energy, adding it to the supply mix will give a much needed boost to the already thriving wind energy industry in Ontario. In addition, it may give the incentive to start building wind turbines in Ontario, which will add jobs. Ontario must also consider conservation because we live in a culture where it is not encouraged and this must change for the future, as oil is expected to run out very soon and we do not live in a universe of plenty; the environment can only provide so much.

Thank you very much and I hope you will consider my submission.
Sincerely,
Miriam Katz.

From what I understand there is a scenario under which 60% of Ontario's energy can come from renewable resources, such as solar and wind power, by the year 2020, without the use of coal power. As a father of a 2 year old living in the City I would be willing to pay much higher energy costs in return for clean air to breathe for my children and their children.

Presumably the extra cost would at least partly be offset by the savings enjoyed by the health care relieved of some of the burden of those with respiratory problems caused by dirty sources of energy. We must start to see the big picture and think long term, or our legacy will be a shameful one.

I hope that the voices in favour of cleaner air are heard in your consultation process.

David Kelman

I am strongly in favour of renewable energy.
I have built an off-grid house in Simcoe County ay my own expense, and am in the process of building a house in central Toronto, cooled and heated by ground source heat.

Anthony Ketchum

Chief Executive Officer
Ontario Power Authority

Dear Sir,

Congratulation on assuming System Planning function of old Ontario Hydro, which was liquidated by the government of the day in 1993, and was absent for 12 years I hope you are successful in your difficult and challenging task.

Ontario Clean Air Alliance's strategy to obtain 60% of our electricity supplies from renewable sources, and Pembina Institute findings are absolutely unrealistic, and ridiculous.
Natural gas is too precious resource, and expensive, to be burned to produce electricity. Burning gas will not help to satisfy Kyoto Protocol, and will significantly increase cost of power, which is unacceptable to the industry and consumers.

Real conservation measures should be practiced, and government should offer substantial financial incentives to the consumers/users. As far as new generation is concerned, which is required tor replace the ageing plants, the only solution is nuclear. However new untried, prototype reactors should be avoided. Stock market, which is a good forecaster of the future, believes in nuclear power, by higher prices of uranium stocks.

Your organization should also look back on the previous plans of Ontario Hydro, and seek wisdom and advice of old system planners who may still be available.

Yours sincerely,

Jan Krasnodebski

B.Sc.(Eng) MBA P.Eng

Our ideas / concerns as ratepayers and residents of this province:

We firmly believe that diversification is key in order to provide a reliable and affordable supply of electricity. This includes domestic baseload nuclear and coal / clean-coal generation as well as hydroelectric and renewable technology.
The main concern to us is that electricity remains affordable to both residents and industry. Ontario cannot afford to fail its industry and cause it to relocate to other provinces or countries where energy demands are met at a much lower price than in Ontario.
Burning natural gas to generate electricity puts generation in direct competition with residential consumers and industry relying on natural gas a feedstock.

Let's take a step back from fancy promises and use our current assets to the best of their abilities while working on and implementing a long term plan for Ontario's electricity needs.

Throwing billions of dollars worth of assets out the front door by shutting down coal-fired generation (especially the Lambton GS as one of North America's cleanest coal-fired generators) is acting in bad faith and with no regard for Ontario residents.

Using natural gas (a very potent greenhouse gas itself) with a current North American leak rate of around 4% makes it more (almost twice as) damaging to the public's health as burning coal.

Ontario should also retain future investment inside Canada as opposed to contracting it out to a "partner" like the United States who shows no regard for anybody but itself. (The United Stated seem to have found out for the past 10 years that relying on natural gas to generate electricity doesn't produce the wanted result and is currently building coal-fired generating stations - let's capitalize on this insight.)

Let's also rely on realistic numbers regarding potential generation of electricity through alternative methods (biomass, wind, solar) as opposed to announcing hundreds of megawatts coming online to replace coal while ignoring the fact that it will take years to erect these facilities and forgetting their low efficiency.

Metering electricity consumption can only shift the use of electricity so much - calling for residents to reduce air-conditioning in sweltering heat is admitting a failed long term plan to provide enough affordable electricity. The use of incentives would be much more efficient (carrot vs. stick approach) and public information campaigns to educate residents are needed. However, this will take time - likely 10 to 15 years to dramatically change attitude.

By throwing out affordable generation and replacing it with high-cost and much more volatile generation such as natural gas can only mean an equal sticker shock as we are currently experiencing with gasoline. By the time industry and residents are paying an overinflated and unnecessarily high price for electricity it will be too late to turn Ontario around and we will see more industry move elsewhere (as well as residents).

We hope that you will include our views into your submission. We also hope that your submission will be read, understood and acted on and not have only the convenient parts quoted to support the current policy.

Regards,

Kuhl Family

- Appropriate analytical planning approaches that focus on assessment of risks, environmental attributes and cost characteristics of various portfolios. The approaches will be of the greatest value where they include assessments of the risks that could affect portfolio performance, including financial, market, environmental and other quantifiable and qualitative risks.
- Appropriate approaches to constructing CDM ("Conservation and Demand Management") portfolios for inclusion in long-term plans. These approaches will be of the greatest value where they include established data on technical and achievable potential, costs, implementation barriers, sector specific characteristics, experience in implementation of CDM, and technology developments.
- Assessments of different supply technologies and resources in the Ontario setting, including (but not limited to) natural gas generation, coal gasification, nuclear (new and refurbished), wind, biomass and hydro-electric resources. The assessments will be of the greatest value where they (1) utilize recent source information or current data on capital and operating costs, performance characteristics, technology life cycle, environmental impacts and any other relevant characteristics and (2) present data on a consistent basis across the supply technologies and resources that would be suitable for planning studies.
- Appropriate methods to assess the impact on the natural environment of supply options. The methods will be of the greatest value where they are: (1) methodologically suited to long-term planning; (2) provide for identification and quantification of relevant environmental factors for assessment; (3) capture the cumulative environmental impacts; and (4) provide indications of the sustainability of options and supply mix plans.

Subject: Supply Mix Submission

In response to your request for submissions I would like to offer the following.

Ontario businesses providing good paying jobs require competitively priced electricity to compete in the global market if there is to be a future for Ontario and it's youth. Without it, Ontario and its youth can look forward to relatively low paying call centre type jobs which would be difficult to support a family on. Ontario also needs to develop a better working relationship with industry and should work with industry to solve problems rather than coming up with policies to drive investment out of the province. The province of Alberta is looking like a pretty good place to move to since a lot of business and investment seems to end up there.

Ontario should be self sufficient when it comes to electricity supply, buying only on the spot market for emergency situations or when the price AND environmental impacts are lower than electricity produced in Ontario.

Ontario's sources of electricity supply should be as diverse as possible to minimize the impacts of significant prices increase of individual sources which would significantly affect the prices of electricity. I am deeply concerned about the provinces planned use of natural gas to generate 25% of electricity and what it will do to the price of electricity and natural gas and how it will affect the supply of natural gas in the winter time that I use to heat my home. All forms of electricity generation should be considered for future supplies in the province including nuclear (new and refurbished), existing coal made as clean as possible, and coal gasification. The current idea that by Ontario going off coal will somehow influence the Americans to do the same is the one of the most absurd things I've heard in my life. Canada, let alone Ontario, can't even get the Americans to leave up to agreements they have signed, ie softwood lumber.

Renewables are a good thing but the price must be considered and lower cost electricity sources are required to off set their cost so electricity stays competitively priced in the province. Expectations for the amount of electricity available from renewables should be realistic and backed up by clean affordable energy sources. The rest of the province where there is relatively little wind is unlike Queen's park where there are usually warm winds blowing and again the contribution from wind turbines should be realistic.

In terms of conservation I wish the government would give their head a shake or stop trying to convince me smart meters are going to help save electricity. Our family does many things to miminize our electricity use and the best they could possibly do is shift our use to even later in the evening. If they do come they will be a constant reminder of something forced down our throats by the government that seems to work in relatively few places around the world. The government instead should consider minimum efficiency standards for items sold in the province. This would require products which use electricity with more efficienty rather than products which have the lowest cost electrical components in them that likely could use electricity more efficiently.

Being an organization which is supposedly arms length from the government, submissions differing from government policy should carry equal weight as any others.

A response indicating my submission was received would be greatly appreciated.

Thank you,

Dale Lane

To Whom It May Concern:

I am glad for the opportunity to submit comments on the proposed power mix.

I believe that this is an opportunity for the Province of Ontario to become a leader in renewable technology in North America. The first request for renewable power contracts was an excellent first start and I hope that these continue.

Net metering should be explored further so that small producers would have an incentive to produce and sell power back to the grid. This would got a long way to increasing the prevalence of community power and distributed generation.

I would also like to say that I am disgusted by the commercials by the Canadian Nuclear Association that are currently playing and I hope that the Province in no way supports these commercials (although I do note that OPG is a member). Nuclear is not a safe and clean technology. I have heard Murray Elston speak once and noted that the arguments used to position nuclear favourably against renewable technologies are laden with false assumptions. For instance, they argue that the "footprint" of nuclear is smaller than that of wind. However, the mining and storage for nuclear are not considered part of its footprint, but virtually the entire land through which the wind might flow are considered part of its footprint. That's ridiculous.

Nuclear is also very expensive and unreliable and has a toxic lifespan that makes the storage of by-products unsafe, particularly in this era of widespread terrorism.

Please consider making renewable energy a greater part of the supply mix and removing some of the legislative barriers and subsidies to other technologies that prevent many potential smaller producers from being economically viable.

Sincerely,

Stephanie Lane
Toronto

The future energy sources for the province of Ontario should be affordable and competitive for the people and many businesses that rely on reliable and affordable power.
The province should be self-sufficient for electricity supply in all forms of clean energy including new clean fossil fuels, nuclear and hydro-electric stations and also make some of the existing hydro-electric units more efficient.
There should be an energy supply mix including a realistic supply from renewables.

I believe conservation programs should be put in place eg. better insulation requirements & programs, more efficient hot water tanks, more efficient appliances and programs for manufacturing on energy reduction, because smart meters will not reduce electricity consumption.

L. Lavender

To the Ontario Power Authority:

As a resident of Ontario, I would like to urge the Ontario Power Authority to maximize the province's development and use of renewable and "green"
energy sources--such as wind power, bio-mass, water power, and solar energy.
I would like to see a complete phase-out of nuclear power and (dirty) coal-fired power plants.

Equally important, we need to emphasize conservation. And to that end, I'm in favour of increased energy prices, as well as incentives to lower energy use or switch to green power.

Yours sincerely,
Vivien Leong

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Vivien Leong
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To whom it may concern,

I very much appreciate the opportunity to express my comments on the Minister's requests of the OPA on supply mix. The OPA seems to be on the right track with its focus on explicit assessment of risks and exposures and recognition of the value of flexibility in generating assets.

Flexibility in generating assets is the key to having clean, competitively priced electricity for Ontario residents and businesses. As with everything in life, one must not put all ones eggs in one basket. A generating mix which includes nuclear, renewables, and fossil fuels ,including responsibly managed coal fired generators, is essential to keeping Ontario electricity prices and hence Ontario businesses competitive.

In the past few years the price of natural gas has tripled, yet Ontario residents and businesses are faced with an electricity plan which will shut down low cost coal fired plants in favor of building more natural gas fired plants. The economic risk of relying on natural gas fired technology for baseload generation in Ontario is simply too high.

Assessments of different supply technologies should not only include natural gas, nuclear and renewable technology. Back end technologies for existing coal fired plants such as selective catalytic reduction units and flue gas desulphurization units should be serious considerations for Ontario's supply mix. Lambton Generating Station's Units 3 and 4 are examples where these technologies have been successfully implemented. Coal has traditionally been stable in price and can also be supplemented with other types of fuels such as biomass to reduce emissions.

Ontario needs to be self sufficient in its power needs. This past summer has seen electricity imports regularly reaching and exceeding the 2500 MW range. This electricity has been imported at prices several times higher than Lambton Generating Station's production cost and from coal fired plants within Ontario's air shed that are not equipped with back end technology. This clearly goes against the Ontario Government's principle of supplying clean, affordable power to Ontario customers.

Back end technology for coal fired plants can be installed with little disruption to Ontario's power supply and will save billions to the Ontario taxpayer by keeping much needed existing coal fired generating plants operating in the province. In a time where electricity conservation is clearly not having the required effect, Ontario needs to look at its existing facilities to bridge the gap between new renewable energy generation and new affordable baseload generation.

Alain Levesque

Subject: Conservation and green power

Why are you stalling? It doesn't make sense to me. Conservation is obviously the first major step to take – big-time conservation. And the move to generating green power is long overdue. Right now you're taking pin steps. Be bold and step forward with giant steps. It's a long journey to get to significant green power generation but you've got to start now. No dilly-dallying! Brad Liptrot

August 13, 2005

To the Ontario Power Authority,

I am responding to the request for public input into what future power scenarios the Ontario Power Authority (OPA) should analyze before developing its recommendations.

I believe it is very important for the OPA to include a strong conservation and renewable power scenario in its analysis. Ground-breaking research conducted by the Pembina Institute indicates that it is quite possible for Ontario to get 60% of its electricity from renewable sources by 2020 while eliminating dirty coal and nuclear power. I support the immediate elimination of dirty coal power, but I also reject the idea that nuclear power is a solution. Nuclear waste is legacy I do not wish to leave to my children or the world. Renewable sources, including but not limited to solar, wind and biomass, must be pursued vigorously and expediently.

I am writing today to ask the OPA to include a scenario with a minimum of 60% renewable electricity by 2020 and a full phase-out of dirty coal and unreliable nuclear power. I strongly support a new and sustainable approach to powering Ontario.

Sincerely,

Alex Lisman
Ontario resident, voter and taxpayer

To whom it may concern;

I am writing to you on behalf of the Community Environment Alliance of Peel as well as a York Region Pollution Prevention stakeholder, in the hopes of convincing Ontario Power Generation of the severe environmental, socio-cultural and economic consequences of continued reliance on coal and fossil fuels, including nuclear energy to meet the increasing energy demands of Peel region and Ontario in general.

According to the Ontario Medical Association 2002 publication on the health affects of air particulates, carbon dioxide, sulfur dioxide and other toxins released from burning coal, not only has the rate of cancer, heart disease an respiratory illness increased dramatically, but also asthma as well as depression and mental illness, as a result of chemical disruption of chemical pathways and energy within the body (OMA, 2002). Further findings have shown that it is time for a change, and that we must act NOW, to ensure the social wellbeing of a growing population within Ontario, as well as the ecological wellbeing and function of ecosystems that are severely stressed and threatened with continued collapse, as a result of increased smog and air pollution.

I am currently working with the Toronto and Region Conservation Authority biomonitoring program, and am responsible for monitoring water quality along the Humber watershed. The release of CO2 and nitrous oxide, sulfur dioxide and other bi-products of fossil fuel and coal use, has drastically affected lakes and rivers in Ontario. I would like to see the discontinued use of fossil fuels and coal, which have been in use since the Industrial revolution began.

OCETA, large and small businesses as well as Stephan Dion (the Minister of Environment of Canada) has signaled the need for cleaner, more affordable and healthier forms of renewable, alternative energy for Ontario's power grid. OPG has continued to use a piecemeal, band-aid approach to providing power for quite sometime, even after the 2003 Summer blackout (which should had acted as an indicator that it is time to invest in renewable energy). The current reliance on non-renewable, dirty forms of energy, that cause cancer, negatively impact the environment and the communities in Canada, is not acceptable, is not responsible and is not sustainable. How long does OPG want to continue using coal and fossil fuels to provide people with energy?

Canada is a staples Economy that relies heavily upon natural resources. That does not mean we should waste them. I equate OPG stations and coal plants with a house that has many cracks, crevices, an old furnace and a water heater that is inefficient. The owner refuses to repair the house and to retrofit it, or install an energy saving, cost efficient and environmentally friendly alternative. The owner of the house (in this case OPG) even refuses to have an Energy Audit done by Energuide or other organizations willing to help it.

This analogy makes the message clear: OPG it is time for a change: NOT NUCLEAR POWER (which will only threaten future generations), NOT CLEAN COAL (WHICH

WILL CONTRIBUTE TO CLIMATE CHANGE AND GLOBAL WARMING) and not NATURAL GAS (which will run out by 2020).
OPG needs to phase out coal by 2008 (which it has promised to do), and phase in Wind generation, solar energy and biomass. These forms of energy already have a strong market and demand in Ontario: there are already suppliers of clean sources of energy, such as solar, wind, thermal and biomass, which means that OPG's continued reliance on non-sustainable, dirty and unhealthy forms of energy, such as coal, is preventing the transition to a revolution in energy for Ontario and Canada. It will mean 1 million less hospital visits every year, and will set an example for businesses, as well as individuals, in the hopes that they will take on the One Tonne Challenge, and reduce their emissions and waste generation.

The time is now, no more bureaucracy, no more stalling. OPG is responsible under Canada's Climate Change plan and Kyoto to reduce emissions by 20%. If OPG is up for the challenge it will receive grants, as well as financial incentives from the Provincial and Federal governments, that will make the phasing out of Coal and fossil fuels possible. And citizens under the Environmental Bill of Rights and the Canadian Environmental protection Act, will only continue to pressure OPG and other coal polluters, in the future to take positive, informed actions that are well thought out, and help people, communities and the environment, instead of destabilizing communities and destroying the environmental integrity of areas and landscapes.

In addition, the Pembina Institute indicates that it is quite possible for Ontario to get 60% of its electricity from renewable sources by 2020 while eliminating dirty coal and nuclear power.
OPG's current reliance on fossil fuels and coal in particular has meant an escalating death rate in Ontario from cardio-respiratory and circulatory illnesses, as well as heart attack, stroke. The rate of Asthma and bronchitis is on the rise.

OPG please use the Precautionary Principle, for our sake. You are responsible for our air quality, please do your research, and make the right choice for us, and future generations of people, as well as for Ontario's environment.

Sincerely,

Leslie Luxemburger

Re OPA Submissions for Ontario's energy mix.
I believe that Ontario's energy mix should include Nuclear, hydraulic, Thermal(coal), and renewables. To eliminate any one fuel source will weaken Ontario's economic position and place a great burden on both our elderly on a fixed income and our ability to compete industrially. Ontario's coal fired plants can be made to operate in an environmentally friendly way as evidenced by the clean coal technology already installed at Lambton Generating Station units 3 & 4. Ontario has historically been a net exporter of power but recently has become a net importer of power. This must stop. We must become self sufficient in our energy needs and even more importantly, we must not give up our publicly owned system to privately owned and foreign companies. Renewable sources have a role to play but to rely on them to provide base load power is a scary proposition. Therefore I believe that all Ontario's coal fired plants should be equipped with clean coal technology similar to Lambton G.S.

I look forward to hearing from the OPA regarding this submission

John Maccio

Dear Reader,

After reading a book entitled "Fueling the Future" edited by Andrew Heintzman and Evan Solomon, I became excited about the very realistic possibility that I could live in a province that utilizes renewable resources for the purpose of generating electricity.

This book, however, points out both the good news and the bad news regarding the development of renewable energy technologies and speaks to the fact that marketable renewable energy technology is still- because of financial and political obstacles- years away. This book also reveals that renewable energy is a realistic and necessary goal; we have the know-how, the materials and the motivation to make it happen and it should be happening now.

It seems to me that there are extremely legitimate reasons to support the cause to adopt renewable energy technology to meet Ontario's electricity demands: global warming, pollution, human health; and it seems that the forces for and the forces against renewable energy are both strong enough to force us, as citizens and leaders, to question what we believe in and then choose sides. The way I see it, we can continue to use non-renewable energy and face the adverse environmental consequences (which could cost billions) or we can commit to making the change to renewable energy and reap the benefits of a healthy Ontario.

Here is my recommendation:
1. Over the next 10 years, upgrade our coal burning power plants with coal gasification and carbon sequestration technologies to produce "clean-coal." By 2020, clean coal should account for 40% of Ontario's electricity. Sell the hydrogen that is produced as a by-product of coal gasification!
2. Invest in the windmill technology coming out of The Wind Turbine Company. By 2020, 30% of Ontario's power should be wind generated.
3. Provide incentives for homeowners and the private sector to invest in solar energy. By 2020, the goal should be affordable solar power for homeowners to the extent that we would be crazy not to get a solar powered water heater!
By 2020, 30% of our power should come from the sun.

Let's help make the change!

Best wishes,
Tanya Markvart

Hi there,

RE: future power scenarios input

I'd like to see a mix of 25% nuclear, 50%+ renewables, and 25% hydrogen fuel cell or natural gas or oil (however by 2020 fossil fuels will be so expensive it's best to stay as far away from fossil fuels in the long term). Conversion of the Lambton plant to high efficiency natural gas would be a good thing to do quickly.

Please, NO more coal plants and much less reliance on expensive nuclear. Nuclear is only suitable for baseline loads since they can't be switched on and off at will. Nuclear is too much of the mix currently considering the fact that there is still no long-term multi-century solution for the waste. Any new plants need to use something more reliable than the CANDU model.

If the government would get on with subsidizing renewables and issue major tax credits for solar roofs or farm turbines then the resulting distributed home power generation will easily help increase renewables to 50% by 2020. The technology is already available and has been for years, the will is simply needed on a political level to subsidize them the way fossil fuels are/were!

Political will to enforce mandatory efficiency standards for cars and appliances will help our fuel sources last longer. If it's not Energy Star it shouldn't even be permitted to be sold in Canada.

Here is Ontario Clean Air Alliance's strategy to obtain up to 60% of our electricity supplies from renewable sources by 2020: www.cleanairalliance.org/resource/15month.pdf

Net metering also needs to be available across the province asap by ALL utilities. The US is way ahead of Canada on this and we need to catch up in a hurry. Home users should also be paid for excess generation of power - currently the proposal would pay nothing when people generate more power than they use, they simply get credited for their monthly use, nothing beyond that. The lack of payment is a disincentive that will discourage people from installing extra capacity when they install home power generation systems. If they were paid like any other power producer if they produce extra (even if it's just 2-5 cents) it would help.

Conservation methods of course are also important, such as remote monitoring systems that turn off household AC's for 15/30 minute periods during power shortages.

Erin Martijn

Please include a strong conservation and renewable power scenario in your analysis. Ground-breaking research conducted by the Pembina Institute indicates that it is quite possible for Ontario to get 60% of its electricity from renewable sources by 2020 while eliminating dirty coal and nuclear power.

Please include a scenario with a minimum of 60% renewable electricity by 2020 and a full phase-out of dirty coal and unreliable nuclear power.

Thanks,

Wendy McDonnell

27 Jane Street, Guelph

Subject: energy needs

Re: Ontario's future energy needs: We wish to strongly encourage you to fully explore the opportunities for -

1. conservation of energy. We are way behind the Europeans on this so this must be corrected!
2. development of re-newable non-polluting energy sources.

It is in everyone's interests to reduce air pollution so please continue to phase out coal-fired generating plants. Altho I would also like to see a phase out of nuclear power generation I realize that this may continue to be necessary until other sources are developed.

Good luck!

Allan and Dorothy McKeown

Sarnia, Ontario.

1442 Firwood Cr.,
Peterborough, ON.
K9K 1J1.
29 July, 2005.

Ontario Power Authority,
Supply Mix Submissions,
175 Bloor Street E.,
North Tower, Suite 606,
Toronto, ON. M4W 3R8

New Renewable Energy Recommendations

Chairperson;

Our professional group is pleased to submit a recommendation for new renewal energy capacity for the province of Ontario. With all due respect we ask the Authority to give this recommendation serious study.

On the 9th of January, 2004, the Electricity Conservation and Supply Task Force (ECSTF) submitted a final report to the Honorable Dwight Duncan, M.P.P., Minister of Energy for the Province of Ontario.

Section 5.3 of the ECSTF report addresses **Renewable Energy** under five source classifications -

1) Water
2) Biomass
3) Wind
4) Solar
5) Geothermal

1) Water Power:

Hydro sources are estimated to have a potential of 1200 to 4000 megawatts of ***base load/peaking*** energy. This potential is significant when viewed against Ontario's future energy requirements. but represents only a small percentage of the "supply mix" equation.

2) Biomass:

Biomass represents a valuable ***renewable energy*** source.. The universally accepted definition of biomass is organic matter, including living cell material which can be processed to produce electrical and thermal energy. The ECSTF report downgrades biomass potential to 1700 megawatts by excluding 3000 megawatts of energy potential from municipal solid waste (MSW). Internationally, municipal solid waste is recognized and managed as an extremely strategic ***renewable energy*** source. In 2005, Ontario will destroy over 10 million tonnes of residual solid waste by burying it in landfills. This quantity of waste has the potential to produce over 3000 megawatts of ***'base load' renewable energy*** . Municipal solid waste in combination with a wide range of other types of biomass offers a potential of 4700 megawatts - significantly above hydro, wind and solar. The most significant, sustainable and economic source of renewable energy in the Province of Ontario is the conversion of municipal solid waste to clean energy.

3) Wind:

Wind power has a small but important role to play in Ontario's energy mix . High capital costs, and site limitations coupled with intermittent supply can be expected to limit wind power developments in Ontario. Economic studies of the cost of wind power should factor in the costs of meeting demand when wind power is not available.

4) Solar:
High capital costs for an intermittent energy supply relegate solar to a minor role in the "supply mix" equation.

5) Geothermal:
Not available as an renewable energy source in Ontario.

Recommendation for New Renewable Energy Capacity;

Ontario Power Generation's 722 hectare Wesleyville property located on Lake Ontario just west of Port Hope is an ideal location for a large waste to energy complex. The complex would function as the cornerstone of a commercial/ industrial development, providing clean energy and waste disposal service to municipalities in southern Ontario. The complex could be designed to feature two large "high efficiency - co-generation" waste to energy plants with a combined base load output of 320 megawatts.

A facility generating 320 megawatts of electrical energy would have sufficient capacity to serve the entire residual waste disposal needs of the Greater Toronto Area and would, utilize rail transportation for waste delivery.

A high efficiency waste to energy complex would apply developed technology to convert 100% of residual waste to useful end products and would have a foot print of less than 15 hectares allowing over 700 hectares for commercial infrastructure (greenhouses, ethanol plants, hemp processing, construction materials, service industries, etc). All basic services are in place.

Ontario Power Generation could take the lead initiative in establishing partnerships with municipalities and industry to finance, build and manage the complex.

Refer to exhibit "1" Wesleyville

B) FUNDAMENTAL ADVANTAGES OF WASTE TO ENERGY

1) COST OF FUEL:

A 320 megawatt waste to energy complex would be fueled by 2.4 million tonnes of residual waste annually. With tip fees estimated at $62/tonne, annual revenue (equivalent to a fuel subsidy) will approach $150 million. This gives the waste to energy concept a significant economic advantage over fossil fueled generators.

2) GREENHOUSE GAS REDUCTIONS:

A 320 megawatt waste to energy complex will provide indirect annual green house gas reductions of approximately 5,000,000 metric tonnes of CO_2 equivalents. These reductions are attributed to the avoidance of landfill emissions, recycled ferrous material and the displacement of fossil fuel generation.

3) DISTRIBUTED GENERATION:

Regional waste to energy facilities address the important requirements for distributed generation that reduces system stress and enhances system reliability. When coupled with high availability, waste to energy facilities meet the requirement for distributed generation

.

4) ENERGY AVAILABILITY:

Waste to energy plants have an enviable record of reliable performance and very high availability (over 95%). When Eastern North America was blacked out on 14 August, 2003, waste to energy facilities in the blacked out areas were the first generators to reconnect to the grid

.

5) ECONOMICS:

The principal factors determining return on investment are fourfold:-

1) Cost of equity and debt retirement schedules.
2) Processing cost which relates to plant capacity.
3) Revenue from the sale of electricity and recycled materials.
4) Revenue from the sale of thermal energy.

In general the waste to energy industry is profitable and operates without subsidies. Debt retirement schedules are typically 20 years with plant life expectancy of over 60 years. Waste tipping fees are competitive with landfill costs which currently range from $55.00 to over $100.00 per tonne. In traveling extensively in the United States we found many waste to energy plants subsidize community recycling and composting programs. Joint ownership is favored and works well throughout the waste to energy industry.

C) INTERNATIONAL STATUS OF WASTE TO ENERGY:

1) United States

Approximately 90 waste to energy plants in 29 states serve 36 million people with annual waste processing capacity of 27.5 million tonnes. Annual production of electrical energy exceeds 25 million megawatt hours. For example, Minnesota is building their 11th waste to energy plant in Benson ,Minn. The new plant will generate 55 megawatts of electrical energy and raise Minnesota's commitment to renewable energy. The new plant is being built by S.N.C. Lavalin ,a Canadian contractor.

Refer to Exhibit "2' - Fibrominn WTE Plant

2) Germany:

Germany has 60 waste to energy plants 'on line' with 8 new plants under construction or in the approval stage. Annually, Germany is converting 14.2 million tonnes of municipal solid waste to energy, and with the new plants will divert virtually all residual waste from landfill.

3) Holland:

The Netherlands have 11 waste to energy plants on line and are currently constructing the world's largest high efficiency facility in Amsterdam. The new plant will process 1.4 million tonnes of municipal solid waste annually and supply electrical and thermal energy to adjacent municipal services.

Refer to Exhibit "3" Amsterdam Eco-Port

4) Sweden:

Approximately 70% of Sweden's electrical energy needs are supplied by the conversion of municipal solid waste to energy in modern facilities. Landfills are virtually banned and Sweden's dependence on fossil fuel effectively eliminated.

.D) WASTE TO ENERGY: A RENEWABLE ENERGY SOURCE:

In the United States, 15 states have recognized the conversion of municipal solid waste as a valuable renewable energy source. These states are served by 70 waste to energy plants generating over 2400 megawatts of "base load" electrical energy.

Refer to Exhibits "4 and 5"

E) DOES WASTE TO ENERGY CONTRIBUTE TO GREEN HOUSE GAS EMISSIONS?

Waste to Energy plants reduce green house gas emissions in three ways. First - they reduce the volume of rotting trash emitting methane gas in landfills. Methane, an extremely powerful greenhouse gas , is 22 times more potent than carbon dioxide. Landfills currently release 26% of all methane released in Canada. Secondly - **Waste to Energy** plants offset electricity generation and the associated greenhouse gas emissions from burning fossil fuels. Thirdly - "Biomass" is a term used to include all energy materials that emanate from biological sources, whether they are wood or wood wastes, residue of wood processing industries, food industry, waste products or municipal solid waste. Unlike burning of fossil fuels, combustion of biomass merely recycles the carbon fixed by photosynthesis in the growth phase. On average over 80% of the dry weight of municipal solid waste is organic material.

Refer to Exhibit "6" IWSA fact sheet

F) IS WASTE TO ENERGY ENVIRONMENTALLY CLEAN?

In February, 2004, the U.S. Environmental Protection Agency (EPA) confirmed studies by Columbia and Harvard University which determined that **waste to energy** plants produce electricity with less environmental impact than almost any other source of electricity. A copy of the 14 February, 2004 E.P.A. letter to the Integrated Waste Service Association is enclosed.

Refer to Exhibit "7" E.P.A. Endorsement

G) WASTE TO ENERGY (in British Columbia)

In July, 2003, the Greater Vancouver Regional (GVRD) commissioned a $36 million expansion of their Burnaby **Waste to Energy** facility. A new 15 megawatt turbine generator was added to increase electrical energy revenue by $6 million annually, and provide electricity for 15,000 homes. The additional revenue is to be used to subsidize recycling and composting costs. This facility is now classed as a "co-generation" **Waste to Energy** plant with an annual capacity of 230,000 tonnes of residual waste. GVRD officials describe it as a **Gem of a facility**.

Refer to Exhibit "8" Burnaby B.C.

H) IS WASTE TO ENERGY COMPETITIVE WITH LANDFILL?

Waste to Energy technology has advanced rapidly over the last two decades. High efficiency heat recovery systems, improved combustion controls, utilization of exhaust steam, and processing of plant residuals have combined to reduce the cost of the process. In the same period, landfill costs have escalated sharply with high land acquisition and development costs, high cost pollution control, limited life span and long periods of post closure liabilities.

The Burnaby, B.C. waste to energy facility operates profitably with tipping fees of $42. per tonne. This is a co-generation facility.

Refer to Exhibit "8" Burnaby B.C.

I) COVANTA ONONDAGA, L.P.

The Covanta **waste to energy** facility in Syracuse, New York, operates profitably with tipping fees of 52 U.S. dollars per ton. This facility provides a 100% subsidy to the City and County recycling and composting programs..

Refer to Exhibit "9" - Covanta

I) Background of Recommendation:

In the early nineties an organization of 15 professionals developed an interest in the conversion of residual municipal waste to energy. Over the years, through seminars, conferences, study and extensive travel we concluded waste to energy technology offers Ontario a unique opportunity for the supply of sustainable renewable energy and environmentally clean waste disposal. With no business relationships in the energy or waste management industry our professionals feel well qualified to offer responsible and objective recommendations for renewable energy capacity.

A TIME FOR ACTION:

Over the years we have worked diligently with Government and Ontario waste management officials to enhance an appreciation of the many advantages of **waste to energy** when compared to landfills.

We have reason to believe that Premier McGinty and Minister Duncan are receptive to the **waste to energy** concept as they face into serious energy supply and waste disposal issues.

It is our view that leadership by the Ontario Power Authority will be well received by the Provincial Government.

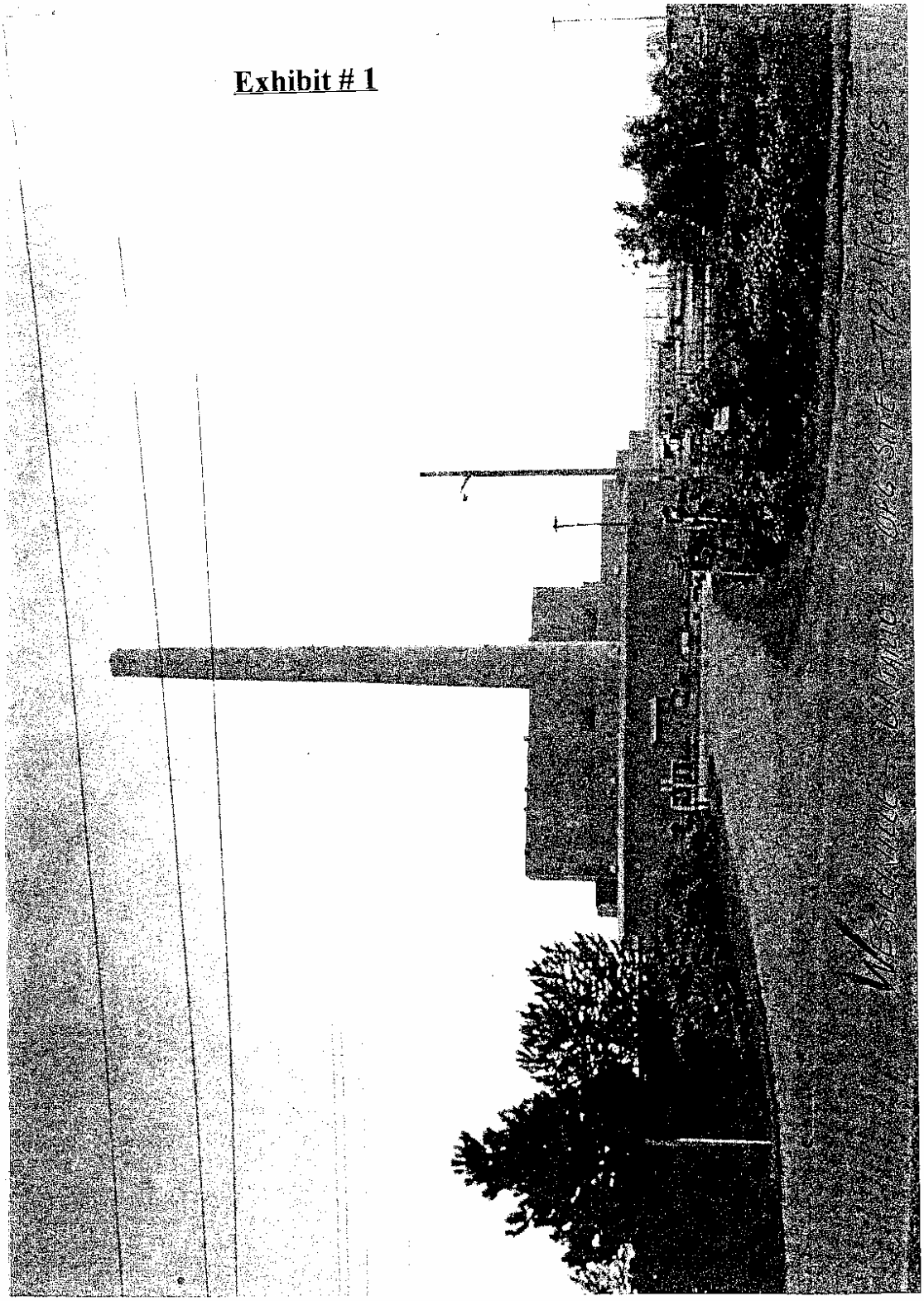
The recommendation in this submission carries significant merit and will move Ontario from the wilderness into a leadership position in biomass renewable energy generation and waste disposal.

Yours truly,

Ed. K. McLellan, P.Eng.,
(705) 748-3923
el.mclellan@sympatico.ca

Copies -
The Hon. Minister of Energy, Dwight Duncan, M.P.P.,
The Hon. Minister of Environment, Laurel Broten, M.P.P.,
Mr. Jeff Leal, M.P.P.
Men's Professional Group (15)

Exhibit # 1



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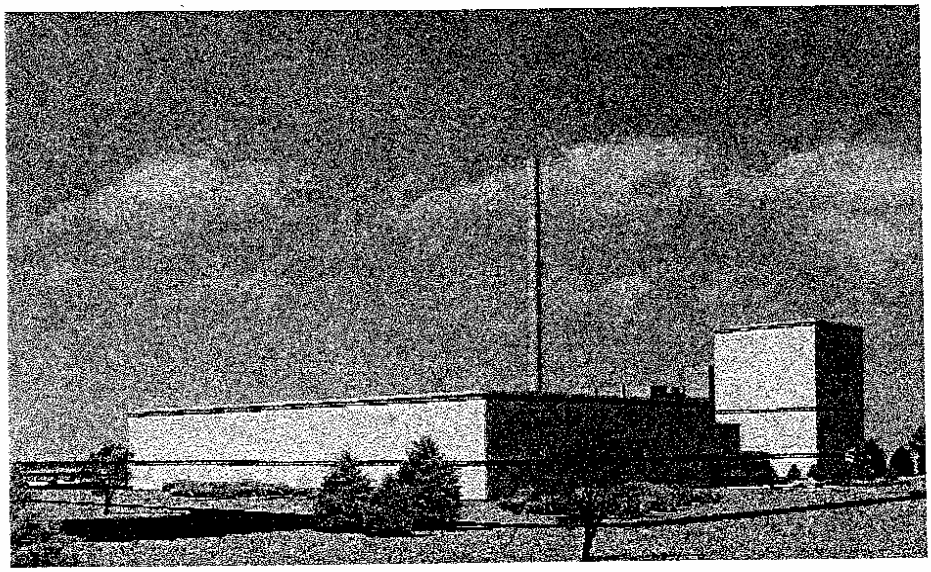


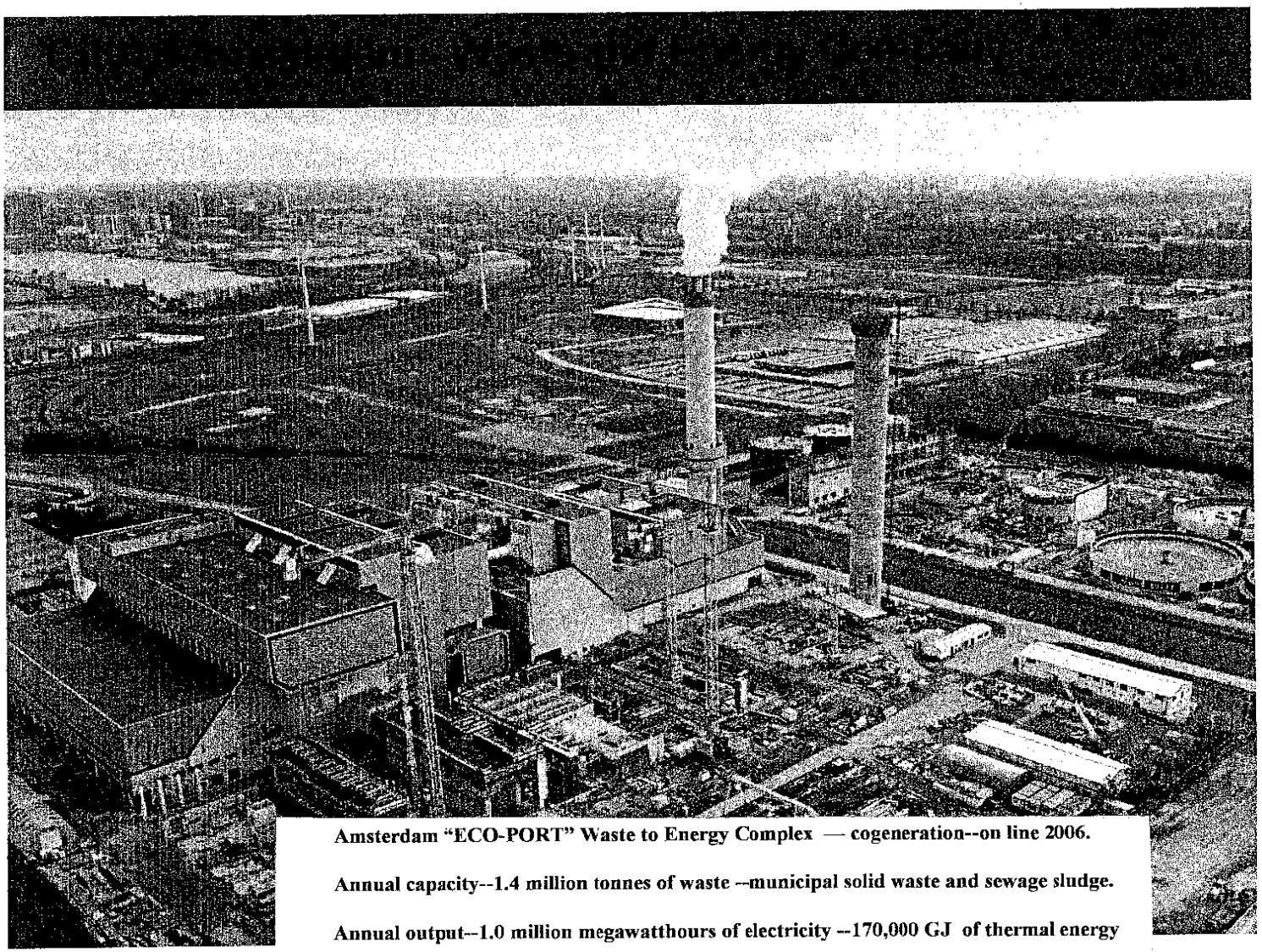
Fibrominn

Fibrominn Biomass Power Plant
Benson, Minnesota
Artist's Rendering
September 2001

Home Page | City of Benson, MN

- MINNESOTA'S 11TH WASTE TO ENERGY PLANT.
- 55 MEGAWATTS OF RENEWABLE ENERGY.
- CONSTRUCTION BY S.N.C. LAVALIN (CANADA.)
- 700,000 TONS OF WASTE PER YEAR.
- JOINT VENTURE WITH BANK FINANCING

Exhibit # 3



Amsterdam "ECO-PORT" Waste to Energy Complex — cogeneration--on line 2006.

Annual capacity--1.4 million tonnes of waste --municipal solid waste and sewage sludge.

Annual output--1.0 million megawatthours of electricity --170,000 GJ of thermal energy

-- 300.000 tonnes of construction materials.

Exhibit # 4

Membership

FAST FACTS

WTE Fast Facts

WasteWorld Curriculum

Informed Sources

HOME

Waste-to-Energy: A Renewable Energy Source

Waste-to-energy is the only renewable energy technology that provides communities with dual environmental benefits: a clean source of electricity and clean trash disposal. In the waste-to-energy process, trash is used as a fuel to generate power such as electricity or steam for central heating or cooling.

The fuel use in waste-to-energy plants to produce clean electricity is municipal solid waste -- our household trash. Trash is both "sustainable" and "indigenous" -- two basic criteria for establishing what is a renewable energy source. Society will continue to generate waste and no one can reasonable claim that waste will ever be 100 percent eliminated.

The U.S. Department of Energy's National Renewable Energy Laboratory (NREL) contends that... "renewable energy technologies are being developed to produce marketable energy by converting natural phenomena into useful energy forms.

"Biomass is a term that includes all energy materials that emanate from biological sources, whether they are wood or wood wastes, residue of wood processing industries, food industry waste products or municipal solid waste. Unlike burning of fossil fuels, combustion of biomass merely recycles the carbon fixed by photosynthesis in the growth phase. On average, about 80 percent of the dry weight of municipal solid waste is organic material."

Return to About Waste-To-Energy

Exhibit # 5

Fact Sheet

WASTE-TO-ENERGY: A RENEWABLE ENERGY SOURCE

For More Information Contact: ***Maria Zannes***
202/467-6240

- The **U.S. EPA** states that waste-to-energy facilities are a "**clean, reliable, renewable source of energy**" and waste-to-energy facilities produce electricity with **"less environmental impact than almost any other source of electricity."** *(Letter to IWSA from Marianne Horinko and Jeffrey Holmstead, U.S. EPA, 2/14/03)*

- The **U.S. Department of Energy** recognizes **waste-to-energy** as a **renewable energy source** and includes it in their tracking of progress toward achieving the Federal Government's renewable energy goal, established by Executive Order 13123.

- The **Federal Power Act** defines renewable electric energy as electric energy produced by a renewable energy facility which produces electric energy solely by the use, as a primary energy source, of solar energy, wind energy, **waste resources**, **biomass resources**, geothermal resources, or any combination thereof.

- The **Public Utility Regulatory Policy Act** definition of small power plant production facility is as follows: The term renewable energy means electricity generated from **biomass, waste**, renewable resources to include wind and solar, geothermal resources, or any combination thereof.

- The **Federal Energy Regulatory Commissions Regulations** (18 CFR.Ch. I, 4/96 Edition, Sec. 292.204) defines **biomass energy** as Any primary energy source which, on the basis of its energy content, is **50 percent** or more biomass shall be considered biomass.

- **The Biomass Research and Development Act of 2000** signed into law on June 20, 2000 defines **biomass** as any organic material that is available on a renewable or recurring basis, including agricultural crops and trees, wood and wood wastes, plants, grasses, residues, fibers, animal wastes, **municipal wastes**, and other waste materials.

- **The federal Pacific Northwest Power Planning and Conservation Act** defines renewable resource to include power generated through the use of biomass.

- The fuel used in waste-to-energy plants to produce clean electricity is municipal solid waste. **Trash is both sustainable and indigenous - two basic criteria for establishing what is a renewable energy source.**

- **Fifteen states define waste-to-energy as renewable power** including California, Connecticut, Hawaii, Iowa, Maine, Maryland, Massachusetts, Michigan, Minnesota, Nevada, New Hampshire, New Jersey, Pennsylvania, Virginia, and Washington.

Exhibit # 6

Fact Sheet

WASTE-TO-ENERGY: Reducing Emissions of Greenhouse Gases with Clean, Reliable, Renewable Power

What is "waste-to-energy"?

Waste-to-energy facilities produce **clean, renewable energy through the combustion of municipal solid waste in specially designed power plants equipped with the most modern pollution control equipment to clean emissions**. Trash volume is reduced by 90% and the remaining residue is regularly tested and consistently meets strict EPA standards allowing reuse or disposal in landfills. There are 89 waste-to-energy plants operating in 27 states managing about 13 percent of America's trash, or about 95,000 tons each day. Waste-to-energy facilities generate about 2,500 megawatts of electricity to meet the power needs of nearly 2.3 million homes, and the facilities serve the trash disposal needs of more than 36 million people. The $10 billion waste-to-energy industry employs more than 6,000 American workers with annual wages in excess of $400 million.

How does waste-to-energy reduce Greenhouse Gases emitted into the atmosphere?

The use of waste-to-energy technology **prevents the release of forty million metric tons of greenhouse gases in the form of carbon dioxide equivalents that otherwise would be released into the atmosphere on an annual basis**, according to an analysis developed by the U.S. Environmental Protection Agency and the Integrated Waste Services Association (IWSA) using EPA's Decision Support Tool program. Annual reporting by IWSA to the U.S. Department of Energy's Voluntary Reporting of Greenhouse Gases Program confirms that waste-to-energy also **prevents the release each year of nearly 24,000 tons of nitrogen oxides and 2.6 million tons of volatile organic compounds from entering the atmosphere.**

America's waste-to-energy facilities dispose of trash, and are an alternative to land disposal that releases methane (a potent greenhouse gas) as trash decomposes. Waste-to-energy also produces electricity, lessening reliance on fossil fuel power plants that release carbon dioxide, another greenhouse gas, into the atmosphere when coal or oil are burned. Operation of waste-to-energy plants **avoid the release of methane that otherwise would be emitted when trash decomposes, and the release of CO2 that would be emitted from generating electricity from fossil fuels.**

In addition to the analysis using EPA's Decision Support Tool, and eight years of reporting by the IWSA to the U.S. Department of Energy, **a detailed, project analysis of a facility's contribution to solving the threat of global warming has been completed** for a 1500-ton-per-day waste-to-energy facility in the northeast. Researchers used information regarding alternative landfill disposal, plant emissions, trash composition and other plant-specific data and analyzed the information using the EPA Decision Support Tool. The study determined that about **270,000 tons of carbon dioxide equivalent emissions are avoided annually because of this one plant's operations.** Company officials currently are talking to greenhouse gas credit brokers about marketing the reductions to buyers of GHG credits.

INTEGRATED WASTE SERVICES ASSOCIATION
1401 H Street N.W., Suite 220 • Washington, DC 20005 • 202-467-6240 • FAX: 202-467-6225

Exhibit # 7

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

FEB 14 2003

Maria Zannes, President
Integrated Waste Services Association
1401 H Street N.W., Suite 220
Washington, DC 20005

Dear Ms. Zannes:

EPA recognizes the vital role of the nation's municipal waste-to-energy industry, and wishes to thank you for your environmental efforts.

Upgrading of the emission control systems of large combustors to exceed the requirements of the Clean Air Act Section 129 standards is an impressive accomplishment. The completion of retrofits of the large combustion units enables us to continue to rely on municipal solid waste as a clean, reliable, renewable source of energy. With the capacity to handle approximately 15 percent of the waste generated in the US, these plants produce 2800 megawatts of electricity with less environmental impact than almost any other source of electricity. With fewer and fewer new landfills being opened, and capacity controls being imposed on many existing landfills, our communities greatly benefit from the dependable, sustainable capacity of municipal waste-to-energy plants.

We applaud the leadership taken by the Integrated Waste Services Association in coordinating research needs to continue to improve the performance of these plants. Your willingness to work with EPA and the State governments on responses to natural or man-made emergencies, including anthrax, is greatly appreciated. Our staff in the Office of Solid Waste and Emergency Response and the Office of Air and Radiation look forward to working with you on defining your research agenda and in addressing our national security concerns.

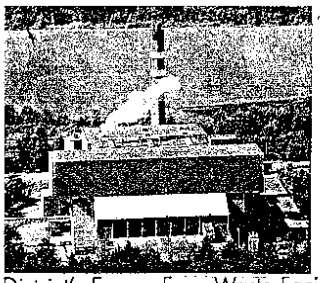
Sincerely yours,

Marianne Lamont Horinko
Assistant Administrator
Office of Solid Waste and
Emergency Response

Jeffrey R. Holmstead
Assistant Administrator
Office of Air and Radiation

Recycled/Recyclable
Printed with Soy/Canola Ink on paper that

Exhibit # 8



by Chantal Babensee, P.Eng

"Greenhouse gas offsets from the energy recovery at the facility are greater than the greenhouse gas emissions from it."

Burnaby Burn

The Greater Vancouver Regional District's Energy-From-Waste Facility

Incineration is a political hot potato in Canada to the extent that in some provinces (such as Ontario) it's currently hard to imagine a new facility being approved. Yet an operation on the West Coast demonstrates that waste-to-energy is an effective means of waste disposal that can co-exist with successful recycling programs. In progressive British Columbia, it appears not to even be controversial. We invited senior staff from the facility to describe it to readers. — ed.

The Greater Vancouver Regional District's (GVRD) energy-from-waste (EFW) facility is an integral part of a solid waste management system which provides disposal services to 21 municipalities and one electoral area in the Greater Vancouver area. This represents a total serviced population of approximately two million people who generate 2.5 million tonnes of municipal solid waste per year. With a recycling efficiency of 50 per cent, the net disposal rate is 1.25 million tonnes per year.

The solid waste management system is comprised of seven transfer stations, two landfills, and one EFW facility. A single regional tip fee of $65 per tonne applies at all facilities in the GVRD system. This fee includes the provision of 3R services, debt retirement, and operation of all facilities. There has been no rate increase since 1991.

Since it commenced operation in 1988, the EFW facility has disposed of 250,000 tonnes annually — about 20 per cent of the total municipal waste disposed in the Greater Vancouver area. The facility is designed to attain a minimum 85 per cent availability and has exceeded this expectation with an average availability of 94 per cent.

The facility has three identical mass burn processing lines; each incinerates 10 tonnes of waste per hour and produces over three tonnes of steam for every tonne of refuse. This produces the equivalent of 175,000 MWh of energy each year. It also has state-of-the-art pollution control technology and has enjoyed many "first" successes in its industry. For example: it was the first in North America to implement a treat-

ENERGY-FROM-WASTE

COPIED FROM SOLID WASTE & RECYCLING
OCT/NOV. 2004
WITH PERMISSION FROM GUY CRITTENDEN
EDITOR

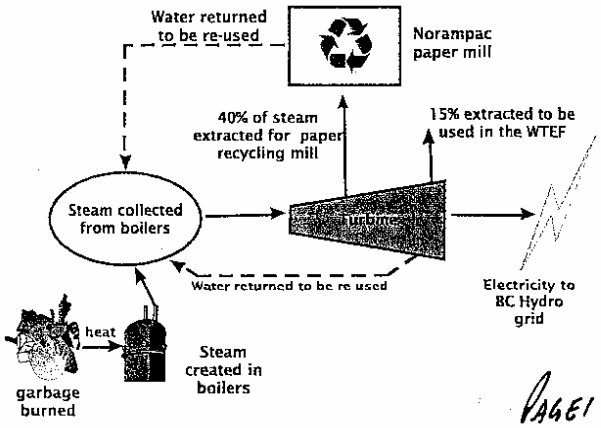
ment system for mercury reduction; first in Canada to install an aqua-ammonia injection system for NO_x reduction; first in Canada to be certified by the International Standards Organization for Environmental Management Systems (ISO 14001); and, it's is the first of its kind in this country to sell both steam and electricity from the combustion of municipal solid waste.

Operations & pollution control

Municipal solid waste is gravity fed onto a grate and burned for a minimum of 30 minutes reaching temperatures of more than 1,000° Celsius. No additional fuel is required to burn garbage during normal operations. The facility is a "zero liquid discharge" operation which means that all the water is reused and no liquid (other than from the washroom facilities) goes to the domestic sewer.

The unburned residue (bottom ash) amounts to about 17 per cent of the incoming

Steam Usage at the GVRD Waste-to-Energy Facility (WTEF)


Water returned to be re-used
Norampac paper mill
40% of steam extracted for paper recycling mill
15% extracted to be used in the WTEF
Steam collected from boilers
Water returned to be re used
Electricity to BC Hydro grid
heat
garbage burned
Steam created in boilers

waste (or 42,000 tonnes per year). Magnets remove over 8,000 tonnes of ferrous metal annually for sale to a recycling company. Bottom ash is used as a road base material and landfill cover at a local landfill (i.e., to displace the use of other materials).

Fly ash, the airborne particulate captured in the air pollution control plant, is treated and disposed of as regular municipal solid waste at landfill at a rate of 9,000 tonnes per year.

Specific air emission limits for the plant are set and regulated by the B.C.'s Ministry of Water, Land and Air Protection. Parameters such as acid gases, particulate matter, metals and organic compounds are measured continuously or through manual stack tests by an independent tester. All actual emission levels are well within the set limits.

In addition to the monitoring of stack emissions at this facility, the GVRD monitors the ambient air environment at 30 sites throughout the Lower Mainland. Of these, three were specifically chosen as key locations to measure the impact of emissions from the EFW facility. To date, no environmental impact has been recorded.

Energy recovery

The process produces steam during the waste combustion process. The heat generated by burning the garbage is recovered by converting water in boilers to steam. An early environmental and revenue-generating strategy was to sell this steam to a nearby paper recycling mill. This mill historically utilized up to 66 per cent of the steam. This replaced steam that that the mill would otherwise have had to generate burning fuel.

Poor paper markets and an aging paper mill resulted in the closure of two of the three paper machines by July 2000. This resulted in a reduction of the steam utilized (to 40 per cent of the steam produced by the EFW facility).

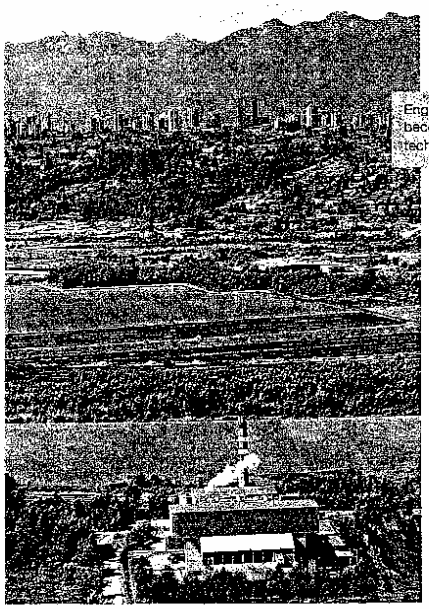
The right conditions were created for the next phase of eco-innovation: the installation of a turbo generator to create electricity from the steam. This presented an opportunity to achieve three goals: create up to 25 MW of electricity with little to no additional impact on the environment; revenue to minimize the cost of waste disposal in the Greater Vancouver area; and, reduce emissions to the airshed by displacing energy that may have otherwise been created through the burning of fossil fuels.

In fact, even though the greenhouse gases are inherently created with any disposal method, greenhouse gas offsets from the energy recovery at the facility are greater than the greenhouse gas emissions from it, so there is a net positive impact on the airshed in that respect.

Recognition

In 2003, the Association of Professional Engineers and Geoscientists of B.C. presented its

ENERGY-FROM-WASTE



Engineering excellence has allowed incineration to become an accepted and fairly routine disposal technology in the GVRD.

first annual Sustainability Award to the GVRD, in part for the installation of the turbogenerator. In addition, in 2004 the facility has won a Power Smart Excellence Award for Energy Efficiency from B.C. Hydro, the Federation of Canadian Municipalities Sustainable Community Award (in the energy category) and the American Society of Mechanical Engineers Best Large Waste-to-Energy Facility Award.

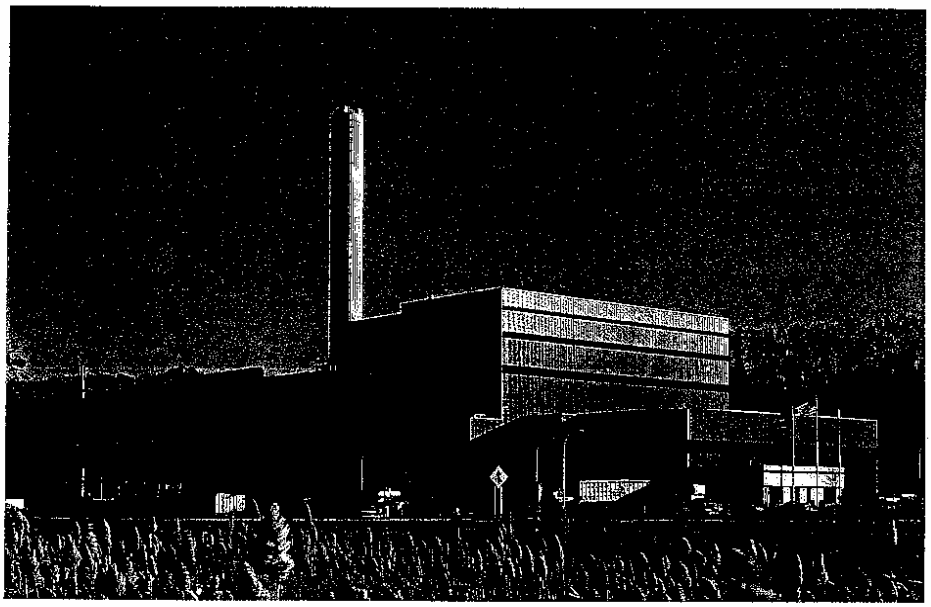
Management is currently exploring opportunities for further eco-efficiency strategies at the plant in support of the GVRD's vision of sustainability in the region. One possibility is to use residual energy from the process to heat a nearby industrial development. Other potential future projects include recovering CO_2 from the stack emissions for industrial use and enhancing the heat recovery already incurring in the plant.

Chantal Babensee, P.Eng., is a senior project engineer with the Greater Vancouver Regional District in Burnaby, British Columbia. Contact Chantal at chantal.babensee@gvrd.bc.ca

Exhibit # 9

Covanta Onondaga, L.P.

Jamesville, New York



The Onondaga County Resource Recovery Facility began commercial operation in February 1995, for the Onondaga County Resource Recovery Agency (OCCRA), which controls the waste flow in the County and the greater Syracuse region. The facility processes 990 tons per day of municipal solid waste, generating up to 39.5 megawatts of renewable energy that is sold to Niagara Mohawk Power Corporation. The facility is equipped with an air-cooled condenser used for condensing turbine exhaust.

The Onondaga County Resource Recovery Facility

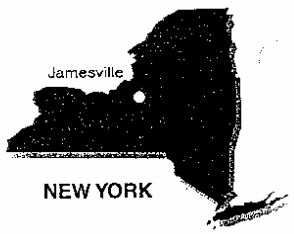
COVANTA
ENERGY

Covanta Onondaga, L.P.

Recycling Waste Into Energy

The facility uses a mass burn combustion system which incorporates the technology of German-based Martin GmbH. Waste is combusted at furnace temperatures exceeding 1,800 degrees Fahrenheit and reduced to an inert ash residue that is approximately 10% of its original volume. The ash will be disposed in an environmentally sound landfill.

Before leaving the facility, combustion air is directed through sophisticated air pollution control equipment, including dry flue gas scrubbers, fabric filter baghouses, activated carbon injection mercury control and nitrogen oxide controls. Facility emissions are strictly regulated by both state and federal agencies, as is the handling and disposal of combustion ash.



An Integrated System

The facility is the cornerstone of the County's integrated waste management system. Accompanied by successful recyclables collection, household hazardous waste days and a progressive horticultural composting program, the County's system works together to dispose of waste with the least environmental impact.

By combusting waste to provide an additional energy source, the facility reduces dependence of foreign oil. Collected household hazardous waste reduces air and water emissions from any disposal site. Leaf and yard waste composting reduces nitrogen oxide emissions into the air and reduces expensive landfilling costs.

The Onondaga County Resource Recovery Facility is located at 5801 Rock Cut Road in Jamesville, New York. For more information or to arrange for a tour, please call 315-498-4111.

Facility Specifications

Rated Refuse Capacity
990 tons per day

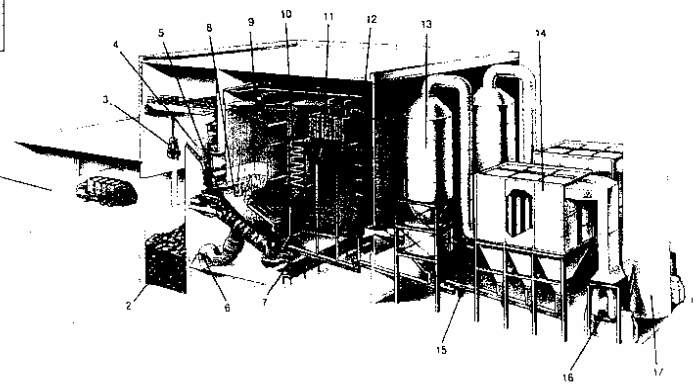
Unit Design
Three 330 ton-per-day waterwall furnaces

Guaranteed Throughput
336,000 tons per year

Guaranteed Waste Delivery
295,000 tons per year

Energy Generation at Rated Capacity
Up to 39.5 MW, sold to Niagara Mohawk Power Corporation

A Typical COVANTA Waste-to-Energy Facility



1. Tipping Floor
2. Refuse Holding Pit
3. Grapple Feed Chute
4. Feed Chute
5. Martin Stoker Grate
6. Combustion Air Fan
7. Martin Ash Discharger
8. Combustion Chamber
9. Radiant Zone (furnace)
10. Convection Zone
11. Superheater
12. Economizer
13. Dry Gas Scrubber
14. Baghouse
15. Fly Ash Handling System
16. Induced Draft Air Fan
17. Stack

Refuse collection trucks are weighed at the scalehouse and monitored for safety. Once cleared, they enter the tipping building and dump their waste into the storage pit. An overhead crane mixes the waste in the pit and lifts the waste up into a feed chute leading to the furnace. From the feed chute, waste is pushed by hydraulic ram feeders onto a stoker grate. The MARTIN Reverse-Reciprocating Stoker is sloped downward and is composed of alternate rows of fixed and moving grate bars. The grate bars push upward against the natural downward movement of the waste bed. This constant movement ensures that the burning waste is continually agitated and pushed back, thus serving as underfire for freshly-fed waste. A forced draft fan supplies the primary combustion air underneath the grate. In addition, overfire air is injected through the front and rear walls of the furnace.

Inside the steel tubes that form the furnace walls and the boiler, heat from the combustion process converts water to steam. The superheater further heats the steam before it is sent to a turbine generator to produce electricity. After passing through the boiler sections, the hot combustion gases are used to preheat boiler feedwater in the economizer.

While the combustion gases move through the boiler, the bottom ash slowly makes its way to the end of the grate where it falls into the water quench trough of the Martin Ash Discharger.

From the boiler, the cooled gases enter the advanced air pollution control system. Using the lime slurry, the dry scrubber neutralizes any acid-forming gases, such as sulfur oxides and hydrogen chloride.

As the gas stream travels through these filter devices, more than 99 percent of particulate matter is removed. Captured fly ash particles fall into hoppers and are transported by an enclosed conveyor system to the Martin Ash Discharger where they are wetted to prevent dust, and mixed with the bottom ash from the grate. The ash residue is then conveyed to an enclosed building where it is loaded into trucks and taken to a landfill designed to protect against groundwater contamination. Ash residue from the furnace can be processed for removal of recyclable scrap iron.

All aspects of the plant's operation are monitored from the central control room 24 hours a day, seven days a week, 365 days a year.

COVANTA ENERGY

Covanta Onondaga, L.P.
5801 Rock Cut Road
Jamesville, NY 13078
315-498-4111

Printed on Recycled Paper

Hello,
I grew up in Alberta and one of the first things i noticed when I moved to Ontario was the air quality, horrible. This past summer was the first summer I spent in Ontario and I was appaled at the amount of smog days you had and how little anyone cared about them, they have become so common people are now used to them and take no notice, failing to change their ways. I think it is VERY important that something is done immediatly to work on this problem. Without action it will only continue to get worse, an example:
temperatures increase - > use of air conditioners increase
-> more green house gases -> increase of temperatures -> more use of air conditioners.....it is a vicious cycle that needs attention. I hope you realize this need and implement a strong plan with strong committment and regulations to keep everyone on track! Canada is in a position to be a role model to the world.

Sincerely,
Leanne Michie

I would ask the OPA and the government of Ontario to increase as quickly as possible the ratio of renewable power that is generated in the province, by means of Standard Offer Contracts and other mechanisms and subsidies that favour renewable power. Such a program should be augmented by a wide-ranging and significant set of incentives for consumers to use less power, by means of giving them a tax break on Energuide appliances, for instance.

Please stay away from the nuclear option. It has proved to be hideously expensive, and there is still no acceptable way of handling the wastes it produces. I would ask you to look at the following recent survey conducted in the UK. (The bolding is mine.)

Voters prefer wind farms to new nuclear reactors

By Angela Jameson, Industrial Correspondent

THE public is sceptical about the case for building new nuclear power stations, despite concerns that Britain may have to rely on imported gas for future energy needs.

Hostility to nuclear power is matched by a belief that renewable sources of energy such as wind farms could fill the gap in energy needs in the next 20 years, the Populus survey finds.

It also indicates that politicians are not trusted to tell the truth about nuclear safety.

The poll found that 59 per cent of those questioned believe that it would be irresponsible to build more nuclear power stations while problems remain in disposing of nuclear waste.

Half of respondents go so far as to say that they believe nuclear power to be unsafe.

Rick Nye, director of Populus, said: “This research shows that, while the public understands the problems of a domestic energy shortfall, they appear reluctant to face up to some of its potential consequences.”

The findings will be a blow to the Government, which has to find reliable new sources of energy urgently, as many of Britain’s older nuclear and coal-fired power stations are due to be decommissioned.

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UK concerned by Iran nuclear moves

Soaring oil prices and fears about the developed world's dependence on Middle Eastern oil have produced a renewed interest in nuclear energy. Some nuclear experts believe that about 80 nuclear reactors will have to be built around the world in the next 10 years.

However, the Government is divided over whether a new generation of nuclear power stations should be built. Ministers have left open the question of whether new power stations should be built; an energy White Paper in 2003 neither backed the building of nuclear power stations to generate cleaner electricity nor closed the door on the option.

No decision is expected to be taken, or even discussed, until a report on how to handle existing nuclear waste has been completed.

The poll also reveals that the public does not trust politicians or energy companies to tell the truth about nuclear power. Only 1 per cent of those polled believed that ministers or MPs would be truthful about safety.

Cameron Miller

[Cook's love 'was greatest gift'](#)

SPECIAL

CHARITY SPECIAL

From: David Wheeler [dlawheeler@sympatico.ca]
Sent: September 6, 2005 10:53 PM
To: OPA (Supply Mix Submissions)
Subject: Re: late submission

Submission

to the

Ontario Power Authority

Supply Mix

From

Millwright and Machine Erectors Local Union 1007

ph 905 227 1007 P.O. Box 8

fax 905 227 6533 Thorold, Ontario

L2V 3Y7

Introduction:

Millwright and Machine Erectors Local Union 1007 will not be able to effectively support its position with facts and statistics. Time is an issue and the OPA has kindly granted the union a little time to complete this late submission.

Millwright Local Union 1007 would hardly have the resources to adequately devise a long or short term plan for Ontario's electrical power generation. It has a membership of only 184 members of which only 134 are active members. They nevertheless regard their opinions as important in this matter.

The unions submission therefore is more about comments based on the concern that if coal fueled electrical generators were to be removed from the electrical generation system industry will suffer.

But being citizens of Ontario they are equally concerned about air quality in Ontario.

This submission is being entered with the approval of the membership of Millwright and Machine Erectors Local Union 1007 by a vote taken at their Aug 29/05 meeting. It is part of an effort the Local Union has taken on to have the Ontario Government rethink its position on coal fueled generators.

Observations

Currently the province of Ontario produces the majority of its power by hydro, nuclear fuel and by fossil fuel. Of the fossil fuel generators those that use coal are the most important. They produce 20-25% of the power requirements of Ontario.

COAL generators are designed around a very simple technology the basis of which has been employed for more that two centuries. They are easy to build, easy to maintain, and produce affordable power at great profit. The fuel they use is coal will be abundantly available for many decades to come.

So on the face of it coal is a good source of reliable affordable power. The draw back is ,of course, the air polluting emissions. The emissions that come from coal generators account for 6-8% of the smog in Ontario. As such coal generation has been blamed for a lot of health problems among Ontarians.

Pollution and global warming are huge problems that must be addressed by humankind throughout the world. Almost all reasonable people feel a need to help bring about a drop in air pollution. Coal fired plants therefore come into the public eye and are viewed on the surface as big offenders.

The truth of it is that the largest contributor of Ontario air pollution are the U.S. industries located upwind of the province which include coal fired generators that have fewer emission controls than do Ontario generators. The second greatest offender is the Ontario transport sector. Significant pollution reduction should therefore be first addressed in those areas.

Pollution from coal burning facilities can be reduced with new technologies. This is pivotal to the Local Unions call here to maintain coal fired stations. The membership insists that fossil fuel generator be maintained and new ones built but only with the strict deployment of emission controls to the best that the industry has available.

Ongoing research must continue as an intrinsic part of the fossil fuel sector of Ontario's power generation.

Finally it should be noted that Ontario is one of the great civilized and technological societies on the planet. It has the wherewithal to discover and adapt technologies that will demonstrate to the world that coal can be used responsibly. The developing nations notably India and China will use enormous amounts of coal to produce electrical power in their rapidly expanding but , as yet, unsophisticated industrial economies. The developed and tested technologies that can make coal more benign will have to come from advanced economies like Ontario.

NATURAL GAS would be the fossil fuel of choice since it is far less polluting than coal. The reliable amount and price put it out the running for as seriously contender for power generation for at least the next decade.

NUCLEAR fuel is currently the source of about one half of Ontario's power. It must expand because it does not produce air pollution and does produce vast amounts of power.

It has been suggested that nuclear replace coal but nuclear has its own draw backs.

First and foremost is the matter of thousands of years of poison nuclear waste. The pollution is not overt like the smoke from coal but is longer lasting and will become an increasing problem as waste builds up over time.

Therefore the nuclear sector can expand only as much as the society it is serving has the capability to dispose of the waste. Part and parcel with that fact will have to be a ongoing concerted effort to develop means by which nuclear fuel can be neutralized. Waste disposal may become a very expensive add on to the cost of a nuclear produced megawatt.

Another drawback to nuclear is the fact that plants are expensive to build and complicated to maintain. Building of a facility will probably take four years if construction were to start tomorrow.

2003. Nuclear took a week to get back on line where all other forms were quick to return.

3

Perhaps the most immediate drawback to nuclear was demonstrated in the summer blackout of

Nuclear will never be able to come back on line quickly in any such circumstance.

HYDRO ELECTRIC generation should be utilized and expanded to its maximum. It is affordable non polluting and employs simple technologies. The plus's far out weigh any down sides that may come with landscape configurations needed to accommodate hydro power.

The Niagara and the 'run of river' upgrades must be continued but after that not much hydro potential is available to the province.

THE BURNING OF BIOMASS alone or in combination with other fuels should also be fully utilized. The best way to introduce the fuel should be in combination with coal since it would be a solid matter that like coal would probably require pulverization before combustion.

WIND energy is promising and should be welcomed everywhere. The propellers that some feel will mar the landscape is a small price to pay for clean power. Lessons could be found in Denmark where they have very successfully implemented wind power.

The great draw back with wind in Ontario is its unreliability . This means that wind will produce power at times when it is not needed and not produce it when it is needed.

It should be welcomed and encouraged to take the strain off other power producers from time to time when the wind is blowing. It cannot be relied upon.

SOLAR power should be regarded in the same way as wind. Equally unreliable.

Wherever possible CO-GENERATION in steel mills, paper mills etc. should be encouraged. They make use out of what is normally lost energy but more importantly they will add to the supply of power.

FUSION reactors cannot be considered until perfected and that is not likely for another decade and a half. Regrettably Canada turned down the chance to participate in the ITER project. Perhaps Ontario can persuade the Canadian government to rethink its position on the matter.

CONSERVATION to the degree that the government hopes for by 2007 is unlikely. The government wishes to create a culture of conservation within the province to such a point that 5% of power usage will be reduced.

Ontario is a province of people who grew up on ample amounts of inexpensive power. No culture can change its habits that rapidly. It will take many years and a lot of education before the people can adjust their thinking. It took years before the people of Ontario fully adopted seat belt use and

the population still struggles with drinking and driving. Even with punitive measures and a plethora of statistics Ontarian's have yet to fully embrace that decades old culture changing initiative.

How is that they will rally behind conservation initiatives?

There also seems to be little consideration to the fact that Ontario industry is the engine of the provinces economy. Asking it not to produce at particular times may never be feasible for an industry in competition with other industries elsewhere.

Conclusion:

Despite a prevailing optimism in upcoming technology that will provide ample clean power the reality is that Ontario produces the greatest amount of power from hydro, nuclear fuel and fossil fuel..

All other means are woefully inadequate or unproven and conservation initiatives are overly optimistic.

Hydro is nearly all used up so that means Ontario will have to expand power production in any area that it can. The only realistic areas for expansion is through coal and nuclear fuels.

There is little question as to the need to expand nuclear despite it leaving a poisonous legacy of radioactive waste. That will have to be dealt with but in the mean time its radioactive pollutants effects can be contained.

Fossil fuel is the only other means by which Ontario can expand production of power.

It is very unwise to deploy only one means of great generation potential. That is to

limit major expansion to nuclear. Ontario must come to terms with coal and burn it as clean as it can.

Fossil stations can be ramped up to take on peak power much faster than nuclear. They can be brought back on line in the event of a major power problem unlike nuclear. They are simple technologies that are relatively simple to maintain and quick to build.

The pollution effects of fossil fuel is immediate and not delayed as is nuclear but technology is moving toward better and better pollution control systems.

Although natural gas would be the fuel of choice it has great drawbacks. Natural gas is in demand for residential and commercial winter heating. Industry and agriculture also rely on natural gas.

That leads to the only rational conclusion. Ontario must come to terms with coal as a method for now and the future to produce power.

5

Recommendations

Ontario must not give into the trendy thinking that predicts that coal fired generating stations can be closed without ramifications. It appears to be a popular myth that many Ontarian’s would like to believe. However the realities of power production make the burning of the coal bridge not something that can

be condoned.

Too much power is generated currently by coal (20-25%) to be easily be replaced by other methods. If the coal fired generators are shut down the province will be reliant on out of province power as it was for much of the summer of 2005. Much of the out of province power came from U.S. coal fueled generators that are upwind of Ontario. They therefore produce pollution that makes its way to Ontario while it pays four times the price of domestically produced power.

Lakeview Generating Station was the first to close under the governments initiative in April 2005. If it had remained open the province would have saved enormous amounts of money. Since pollution came to Ontario on prevailing wind from U.S. generators nothing was accomplished by the closure. The whole episode of the summer demand for power demonstrated the lack of insight of he governments planned closures.

Natural gas is much touted as the successor to coal but the realities are that it will only be effective in small generators or in combination with coal. That is because of its uncertain availability and cost.

A natural gas generator of substantial capacity will probably cause an expensive chain reaction. The huge amounts of gas required will increase demand and therefore the price will increase. The price of power will therefore increase.

Natural gas is not abundant enough to supply the needs of residences, industry, agriculture plus power generation. Coal on the other hand is extremely abundant and affordable.

Coal fueled generators can be used for base line and ramped up for peak power demands. They can be brought back on line at full capacity within a day of a disaster like the summer of 2005.

Coal fueled generators are simple technology that have proven to be hugely profitable produces.

They are easily built maintained and modified. That makes them extraordinarily reliable.

Nuclear on the other hand is best used for stable base line power. Generating Stations are very expensive to build, maintain and not easily modified.

Despite the limitations of the nuclear option it does produce large amounts of power and with coal is the only real solution for future power during the next two decades.

6

All other methods of power production should be introduced into the system and be allowed to develop but they will only be able to take some small amount of strain off coal and nuclear generators.

Conservation is an admiral goal but one that will probably not produce the results the government optimistically foresees.

In any case Ontario’s demand for power will make shutting down any major producer preposterous before replacement power can be produced economically.

Ontario is in a similar position to what it was after each world war. At those times it was in need of power. The province of those times answered with enormous building projects to produce power.

Building power stations of every ilk but particularly nuclear generators and coal fueled generators with advanced pollution controls are the only real solutions to Ontario's future power needs.

Written for Millwright and Machine Erectors Local Union 1007

by Dave Wheeler- member,President and Political Action Spokesman

> ----- Original Message -----
> **From:** OPA (Supply Mix Submissions)
> **To:** David Wheeler
> **Sent:** Friday, August 26, 2005 5:40 PM
> **Subject:** RE: late submission
>
> Dear Mr. Wheeler,
>
> August 29 is the official deadline for written submissions, however we will accept your submission after this date. We appreciate your efforts in assisting the OPA provide the Minister of Energy with advice concerning Ontario's future supply mix. Please note that we are working under a very tight timeline and we urge you to submit your feedback as soon as possible.
>
> With best regards,
>
> Supply Mix Team – Power System Planning
>
> **Ontario Power Authority**
>
> 175 Bloor St. E., North Tower, Suite 606
> Toronto, Ontario M4W 3R8
> Main: 416-967-7474
> Fax: 416-967-1947
> email: supplymix@powerauthority.on.ca

web: http://www.powerauthority.on.ca/

From: David Wheeler [mailto:dlawheeler@sympatico.ca]
Sent: August 26, 2005 4:34 PM
To: OPA (Supply Mix Submissions)
Subject: Fw: late submission

----- Original Message -----
From: David Wheeler
To: supplymixsubmissions@powerauthourity.on.ca
Sent: Thursday, August 25, 2005 7:57 PM
Subject: late submission

Dear Madams /Sirs:

I wish to know if you will accept late submissions. The Millwright Local union 1007 of Niagara and Haldimand may want to submit something but will not meet again until Monday Aug 29. I will propose making a submission. It'll probably take a week and it will not be that involved a submission.

Yours Truly
Dave Wheeler
President Local union 1007

Dear Minister Duncan,

I hope the OPA will think generations ahead and in doing so, abandon the unreliable, expensive and waste-producing nuclear option, while adopting several renewable options and stressing energy conservation.

There is thoughtless over-use all around us, from skyscrapers lit up at night to workplaces so cold in summer that employees wear sweaters during heat waves.

Sincerely,

Suzanne Mogensen

(No reply needed...please spare the paper.)

Please include a scenario with a minimum of 60% renewable electricity by 2020 and a full phase-out of dirty coal and unreliable nuclear power.

Thank you.
Cory Morningstar

"When the power of love overcomes the love of power the world will know peace."

Jimi Hendrix

Honourable OPA Administrators,

Since the OPA is seeking public input on what future power scenarios (e.g., different mixes of various power sources and conservation measures) it should analyze before developing its recommendations, I wanted to take a moment to voice my concerns.
I believe it is very important for the OPA to include a strong conservation and renewable power scenario in its analysis. Ground-breaking research conducted by the Pembina Institute indicates that it is quite possible for Ontario to get 60% of its electricity from renewable sources by 2020 while eliminating dirty coal and nuclear power. Please include a scenario with a minimum of 60% renewable electricity by 2020 and a full phase-out of dirty coal and unreliable nuclear power. Alternatives are available and it's long-overdue that Ontario start investing some R&D into wind and solar technology. Europe is light years ahead of us and could serve as a valuable case study. They obviously realized the long-term costs of nuclear aren't worth the short-term political gains. Please invest in Ontario's long-term future by considering environmental alternatives!

Sincerely,

Kari Morrison

Orangeville, ON

To The Ontario Power Authority,

I am writing to express my concerns with the future of Ontario's electricity supply mix. I understand you are currently looking at long term targets for future power needs.

Mountain Equipment Co-op recently purchased enough wind power to run 50% of our two Alberta stores in Calgary and Edmonton, and were looking at having all of our stores powered by wind by 2010.
As a retail co-operative we are trying to set an example, inspire and influence others to do the same.
By setting a target to get a minimum of 60% renewable energy sources by the year 2020, the province of Ontario would be setting an example and a level of commitment that would hopefully be followed by the other provinces across Canada.

I recommend the Minister of Energy make this target a reality and begin the elimination of dirty coal and unreliable nuclear power, and inspire others to do the same.

Yours sincerely,

Dave Robinson

****

David Robinson
Mountain Equipment Co-op
Social and Environmental
Responsibility Co-ordinator

400 King Street West
Toronto, Ontario. M5V 1K2
Tel: 416.340.2667
Fax: 416.340.7708
Visit our website at
http://www.mec.ca
****

Geothermal Systems

The Future of Energy

A Report Prepared for the
Ontario Power Authority

NextEnergy
Geothermal Solutions
www.nextenergy.ca

Prepared by:
David Hatherton
CEO, NextEnergy Inc.
dhatherton@nextenergy.ca
August 26, 2005

NextEnergy
Geothermal Solutions

35 Earl Martin Drive
Elmira, Ontario N3B 3L4
Tel: 1.800.367.9810
Fax: 1.877.684.3112

The purpose of this report is to explore and explain how geothermal technology can be an integral part of managing Ontario's power supply issues. Geothermal technology has the potential to be the single greatest impact on the demand for electricity in Ontario. For the purpose of this report geothermal systems will be referred to as Geothermal Heat Pumps (GHP).

NextEnergy Inc. is a Canadian-owned and operated company located in Elmira Ontario and is the largest distributor of geothermal systems in Canada. Our success is what separates GHP from other renewable energy programs. We are not dependent upon government subsidies to be competitive in the marketplace. NextEnergy and others in the industry have survived and grown as distributors and manufacturers of heating and cooling systems for residential and commercial use. The beauty of geothermal is that every Canadian has access in his/her own backyard to this energy source. GHP relies on the stored energy of the earth for heating and cooling. By using a system of pipes buried in the ground, a mixture of water and environmentally friendly anti-freeze is circulated to generate or dissipate heat. These systems are highly energy-efficient, quiet, and clean.

GHP is a unique technology. It simultaneously offers benefits to its users, to the local and national economy, to utilities, and to society. It increases the comfort of users while reducing their energy bills. It provides local employment opportunities while reducing the trade deficit. It reduces the cost at which electric utilities provide service, and reduces the burning of fossil fuels, thus improving the environment.

Among the benefits GHP offer residential and commercial users are:

- Comfort (an even flow of warmth or cooling throughout the building)
- Reliability (long system life, low repair costs)
- No outdoor unit (reduced noise, no exposure of system to weathering, aesthetics)
- Lowest operating cost of any space conditioning system (according to NRCAN, the U.S. EPA)

All GHP offers an opportunity to heat domestic water, providing additional operating cost savings.

More than any other heating and cooling system, GHP relies on local value-added services. A substantial, sometimes even dominant, fraction of the installed cost goes to local economies.

GHP offer electric utilities increased customer satisfaction and business stability. Once the ground loop is installed, it is likely that a customer will continue to use it indefinitely, resulting in a satisfied customer willing to purchase service from the electric utility for an extended time. GHP offers a flatter load profile, reducing the need for electric system construction while more efficiently utilizing existing facilities, and thus potentially lowering the cost of electricity sold, also assisting in alleviating the need for imported fossil fuels.

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Geothermal Solutions

35 Earl Martin Drive
Elmira, Ontario N3B 3L4
Tel: 1.800.367.9810
Fax: 1.877.684.3112

The geothermal heat pump is a proven technology with a small number of installations occurring every year since the 1940's, and many taking place in the 1980's and '90's. Thus, funds to develop new technologies are generally not needed. Instead, what is required is a format to reduce the barriers to wide-scale acceptance of this technology. Market penetration barriers to GHP technology include higher capital costs than conventional HVAC systems, the infrastructure needed to reduce front-end costs and ensure user satisfaction in all cases, and most crucially a lack of information concerning the benefits and advantages of GHP in the general public and among business and political leaders.

The Ontario government has taken the first steps in ensuring a reliable, cost-effective energy market will exist in the province for many years to come. The importance placed on alternative energy sources and demand-side management strategies are key decisions in ensuring this occurs. Geothermal energy is a large part of this solution, and it is the responsibility of the OPA to determine what the best course of action will be. The remainder of this proposal will focus on demonstrating how GHP will be a critical part of any future decisions made.

Risk Assessment

A significant barrier to the mass acceptance of GHP as a primary option for heating and cooling homes is the higher capital investment. Average costs vary significantly across the province because of high variability in home efficiency, soil conditions, site accessibility, etc. This report will assume a residential 'high average' total installed retail price of $20,000 for a new 2000 sq. ft. house in a Toronto or Ottawa subdivision.[i] The geothermal industry accepts the range of between $10,000 to $25,000 total installation costs in a 2000 sq. ft. home. This can be a significant barrier regardless of the monthly/yearly savings of GHP over other systems. To get past the capital cost issue, a number of provincial governments, municipalities, and utilities across North America have in the past offered and continue to offer programs that make the initial capital investment easier to afford. Manitoba Hydro has been offering loans of up to $15,000 for the installation of GHP in their customers' homes.[ii] The monthly savings over traditional space conditioning systems will aid the customer in paying off the loan. This system is an excellent way to promote GHP in residential settings. The significance to the utility company is that by making GHP more common in Manitoba homes, the base load consumption in has increased while at the same time lowering peak demand.

By converting homes to GHP, the Utility is in effect decreasing the use of natural gas, propane, or oil. These three "traditional" forms of space conditioning only use a small portion of electricity during their run times. By switching to GHP, those homes are now using an increased wattage draw from the added components such as the compressor

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Geothermal Solutions
35 Earl Martin Drive
Elmira, Ontario N3B 3L4
Tel: 1.800.367.9810
Fax: 1.877.684.3112

and pumps. This extra wattage draw gives the utility a larger "slice of the pie" while still adhering to mandates calling for the reduction of energy usage. The reduction in energy usage comes from the efficiency levels of the GHP. In the case of ClimateMaster Tranquility units, the Coefficient of Performance (COP) reaches the 4.0 mark. This means that for every one kW of electricity used by the GHP the system is deriving the equivalent of 3 kW from the earth. In a manner of speaking, the money saved by installing a GHP is not coming out of the pocket of the homeowner, but in actual fact is coming out of the fossil fuel companies in the form of the money that the homeowner would otherwise be paying them.

In another case, Delta Montrose in Colorado has been very successful in promoting GHP installations by handling the ground loop installation themselves and charging the homeowner a commodity based rental of the loop. The capital investment then becomes non-existent, and customer's pay monthly for the use of the loop. This fits in very well with the pre-existing charging/collecting system now employed by utilities all across North America. GHP now becomes a type of space conditioning that utilities in Ontario can promote, install, maintain, and charge for 24 hours a day, 7 days a week, 365 days a year.

Financial risks associated with these types of programs are minimal. With the existing collection abilities of Canadian Utilities, the familiarity of Ontario residents with their monthly electricity bills and the ability of these utilities to generate capital with the assistance of governments and interested private sector parties, there are no significant financial barriers to the immediate acceptance and implementation of rental loops, or capital cost loan programs. It can be easily proven that loop rental prices, combined with kW rates, will ensure significant profit for utilities from homes that have installed GHP.

The Federal and Provincial governments have begun promoting energy efficient technologies since the signing of the Kyoto protocol, programs such as EnerGuide for Homes, and the Ontario Retail Tax Rebate on GHP, now put these systems on par with solar and micro-hydro systems. These programs are effective, but wide-scale usage is not prevalent, and more incentives need to be in place.

The potential market for the installation of GHP in Ontario is endless. There are no significant barriers to the installation of GHP in every home in Ontario. The Canadian building code should be altered to include the installation of a ground loop so that every new home in Ontario would have the opportunity to benefit from Geothermal heating and cooling systems.

Conservation and Demand Management

For the past few years, Ontario has encountered a growing demand for electricity usage throughout the year along with a growing summer peak demand. Also, power-generating facilities are aging and recent legislation to phase out coal-fired generators will continue

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35 Earl Martin Drive
Elmira, Ontario N3B 3L4
Tel: 1.800.367.9810
Fax: 1.877.684.3112

to put an importance on demand reduction/management strategies. GHP provides the single greatest opportunity for the Ontario government to effectively manage the demand side of electricity usage. David Suzuki writes in his 2005 report, Smart Generation: Powering Ontario with Renewable Energy, GHP are "the most cost effective option to provide space conditioning (heating and cooling) in Ontario."[iii] Since 1990, Ontario has become a summer peak region due to the increased use of air conditioners and extreme weather during that period.[iv] GHP have the ability to significantly reduce the summer peaks by lowering kW usage as compared to traditional air conditioners- it uses approximately 50% less energy during peak times. Air conditioners deteriorate in condition rapidly and are least efficient during the highest demand periods, when it is hottest outside. GHP remains constant in its efficiencies regardless of the outside conditions.

According to the Independent Electricity System Operators (IESO), 13 of the top 20 kW usage days on record occurred in the summer months of 2005, and if the summer energy demand growth of 1.3% per year continues apace, we can expect record- setting summers such as that of 2005 to continue. Assuming a growth rate of 1.3% per year, Table 1 shows the peak demand load in the year 2015 will be 26,900 MW, with an extreme weather peak of approximately 30,000 MW.[v] Currently, the available production of electricity, including 6,500 MW from four coal plants, is 29,663 MW[vi]. This means that the province will be incapable of providing enough energy by the year 2015. It also assumes that all power-generating facilities continue to run at current levels, which is not guaranteed to happen, and takes into account the provincial mandate to phase out coal-fired generation by 2007 or 2009. When this is completed, new forms of generation will certainly be needed. The easiest way to make the inevitable transition period as seamless as possible is to lower the demand for energy.

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Geothermal Solutions
35 Earl Martin Drive
Elmira, Ontario N3B 3L4
Tel: 1.800.367.9810
Fax: 1.877.684.3112

Table 1:

Table 1: Forecasted Ontario Seasonal Peak Demand

Year	Normal Weather Winter Peak Demand	Normal Weather Summer Peak Demand	Normal +1 LFU Weather Winter Peak Demand	Normal +1 LFU Weather Summer Peak Demand	Extreme Weather Winter Peak Demand	Extreme Weather Summer Peak Demand
	(MW)	(MW)	(MW)	(MW)	(MW)	(MW)
2003	*23,330*	*23,164*	*24,158*	*24,753*	*24,158*	*24,753*
2004	*24,202*	*23,372*	*24,937*	*23,976*	*24,937*	*23,976*
2005 (18)	*23,988*	23,672	*24,979*	24,896	*24,979*	26,430
2006	24,205	23,991	25,252	25,231	25,818	26,764
2007	24,374	24,301	25,422	25,542	26,008	27,075
2008	24,549	24,627	25,599	25,964	26,198	27,498
2009	24,724	25,045	25,772	26,397	26,408	27,930
2010	24,848	25,228	25,903	26,454	26,521	27,987
2011	25,018	25,534	26,067	26,759	26,707	28,293
2012	25,189	25,840	26,237	27,080	26,803	28,613
2013	25,360	26,158	26,410	27,495	27,009	29,029
2014	25,521	26,461	26,571	27,812	27,191	29,346
2015	25,689	26,874	26,737	28,226	27,373	29,759
Avg Growth (2005-15)	0.7%	1.3%	0.7%	1.3%	0.9%	1.2%

Taken from: IESO website: http://www.ieso.ca/imoweb/monthsYears/monthsAhead.asp

GHP has the ability to reduce energy usage while raising the load percentage in homes and businesses. With the exception of homes heated with electric resistance systems, GHP will increase load usage in homes by eliminating natural gas heating systems. With a COP of 4.0, the GHP will allow the homeowner to reduce usage during peak times of the day while still retaining the comfort of the house. This is achieved by allowing the majority of the heating and cooling to be done during the "off" times of the day where usage and costs are low. When the peak occurs during the day (late afternoon in summer, and early morning in winter), the GHP can ramp down and simply maintain current temperature levels, or if the controls of the home are set well enough, allow the temperature to change a few degrees either way. This loss in temperature can quickly and easily be made up by the efficiency of the GHP during a period of the day when kW costs have fallen. Combined with the 'smart meter" technology coming on line, controls can be designed to monitor kW cost, and change usage accordingly.

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35 Earl Martin Drive
Elmira, Ontario N3B 3L4
Tel: 1.800.367.9810
Fax: 1.877.684.3112

In a report completed by the Geothermal Heat Pump Consortium in Washington, D.C., the impact of GHP on peak load management is outlined as follows. One of the most attractive features of GHP for utilities is that it reduces peak loads. Winter peak reductions can range from 5 to 12 kW per typical residential system. Summer peak reductions, including water heating, can range from 1.5 to 3 kW of peak.[vii] It is critical that peak load management is stressed when looking at Ontario's power issues. As the blackout of 2003 showed, North America's power grid can at times be fragile, especially during peak times of the year.

GHP has the ability to lower peak demand usage while creating a higher base load during valley periods. Suzuki states that if Ontario were to install 125,000 residential GHP by 2010, it will result in a savings of 2,148,400 MWh per year (7.7 PJ). By 2020, the province can install 341,000 residential GHP systems that would save the equivalent of 5,777,200 MWh a year (20.8PJ). These numbers are for residential space heating only and do not reflect hot water generation or commercial/institutional buildings.[viii] In the same document, he states that space and water-heating account for 58% and 21% respectively of total household energy costs. This means that GHP has the potential to account for 79% of the total residential energy usage in Ontario. Assuming the majority, 59%, of Ontario homes use natural gas for heating and hot water.

Supply Technologies

The provincial mandate to eliminate coal-fired generating plants will require the Ontario power supply to be diversified. The eliminated kW will come from a mix of sources as stated by the IESO, but the majority of power generation will come in the form of natural gas-fired electrical generation plants. In discussions with NextEnergy's engineering department, the following argument can be made for the introduction of GHP. Installing GHP in homes will significantly lessen the usage of natural gas in residential space conditioning. The natural gas saved from the installation of GHP in a home could be used to produce electricity. Electricity produced from the natural gas savings can be used to power the installed GHP, and provide surplus electricity production for sale to other markets, or to be used in other areas like the commercial/industrial sector.

When geothermal technology is coupled with high-quality construction techniques and other forms of renewable energy, the various benefits are compounded. NextEnergy's National Headquarters is one of the only zero-emission buildings in Canada. This is accomplished through the use of GHP to heat and cool the building, the construction of a low heat-loss envelope, and the purchase of tagged, on-grid wind power from the SkyGeneration wind turbine located on the Bruce Peninsula. The extra cost of purchasing premium electricity is easily affordable due to the savings provided by GHP and the efficiency of the building (refer to Table 2 for more information). The entire system is projected to result in heating and cooling costs approximately 80% lower

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Geothermal Solutions
35 Earl Martin Drive
Elmira, Ontario N3B 3L4
Tel: 1.800.367.9810
Fax: 1.877.684.3112

than the best alternative (gas-fired furnaces and rooftop air conditioning units.)
Table 2:

NextEnergy National Headquarters Building Specifications:

- 25,000 sq. ft. building heated and cooled using geothermal.
- Ground source loop made of 21,600 ft. of ¾" GeoPipe.
- 100% of electric energy consumed in the building is purchased from Sky Generation, a windturbine located on the Bruce Peninsula.
- Office and warehouse have infloor heating. Piping is installed at 6" centres to allow a reduction in circulating infloor fluids at lower temperatures than conventional infloor systems to take advantage of the inherent efficiency/capacity gains of water-to-water geothermal units.
- Office flooring made with pre-cast foam insulated concrete to help with infloor heating process giving an R20+ insulation value between floors, which concentrates the heat, or cooling.
- Infloor heating and cooling create one of the most comfortable working environments available.
- Co-efficient of Performance (COP) approaches 5 in the office and 6 in the warehouse.
- ClimateMaster Tranquility27 heat pumps with ClimaDry reheat/passive cooling coils, allowing passive cooling on the air side along with forced dehumidification when required to control dew point. These units are located throughout the offices, usually hanging from the ceiling in the hallways.
- Lighting will be provided by next generation T8 instant on, hi-efficiency lights, these lights use less energy while providing superior lighting ability. Additionally, we installed smart occupancy sensors that turn off when no one is in the room.
- Zero combustion within the building creates an offset of greenhouse gas emissions of 150 tonnes annually, or the equivalent to approximately 75 cars annually.
- Insulation within the building is a combination of cellulose, fiberglass, and Styrofoam that results in an R-rating of R46 in the ceiling, R36 in the walls throughout, and R14 under infloor heating/cooling.
- The system is controlled and monitored by an internet browser based computer, that will monitor, manage and display instantaneous energy produced by the geothermal loop and the wind power being consumed. The data is "live" online through an IP address and reflects the actual "real time" loads and consumption of all components in the building. The data is summarized to display on demand economics of the system to communicate the financial and environmental viability of the building.
- With the thermal masses in the 300 gallon storage tanks, the concrete floors and earth loop, we have the opportunity to utilize "time of use electrical" rates by ramping down our energy consumption during high energy cost periods without adversely affecting building temperatures and occupancy comfort.
- A Heat Recovery Ventilation system is incorporated that has fresh air supplied through an Earth Duct 100 feet long to temper incoming air in the winter and summer.
- The warehouse floor can be used as cooling sink for office cooling loads and mixed with earth loop to optimize infloor cooling temperatures using only pump watts not compressor watts.
- 50% of all energy used in domestic hot water production is recycled.
- Domestic hot water generated primarily by desuperheaters off geothermal units.
- The warehouse has a 50' X 6' skylight and translucent loading dock doors which allow sunlight in, assisting in warming of the building, while reducing the number of lights needed during the daytime.
- The building has a "weather station" that collects weather data specific to this site in real time to facilitate an on demand heat loss/gain profile to show real time energy generation from the earth loop and the wind energy consumed. This assists us in running our geothermal system as efficiently as possible.
- 10" pipe runs underground into building for fresh air supply, which is connected to an 85% efficient Heat Recovery Ventilator. Running the ventilator underground assists the entering air in reaching a neutral temperature.
- Earth loop can operate in series with infloor to provide passive cooling combined with forced air humidity control to lower energy consumption in cooling by approximately 80%.

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Geothermal Solutions

35 Earl Martin Drive
Elmira, Ontario N3B 3L4
Tel: 1.800.367.9810
Fax: 1.877.684.3112

The Federal Government of Canada has signed the Kyoto Protocol binding it to significantly reduce the amount of C02 Canada releases into the atmosphere every year. From that agreement came the provincial mandate for Ontario to eliminate coal-fired electric generating plants by 2009. The one-tonne challenge was created for Canadian homeowners to contribute to the goals of Kyoto. By installing GHP, an average 2000 sq. ft. home will save approximately 9.81 tonnes of C02 every year. The house used in this calculation utilizes a 4 tonne geothermal unit; therefore, for each tonne of GHP installed in a home, 2.45 tonnes of C02 are saved every year. This calculation is set against the use of natural gas as the primary heating source. If other types of fuel are used, such as propane or oil, the tonnage savings increase.[ix]

Geothermal technology is the only technology that is practically capable of significantly reducing electricity demand immediately. The wide-ranging acceptance of GHP will create a long-term, proven solution for electricity conservation and peak load management. This technology is not new, and investment in its development is unnecessary. Instead, promotion and publicity is what is needed at present. An information campaign to remove the barriers to acceptance of GHP on the part of the general public would result in a rapid growth in the use of GHP in Ontario. Geothermal technology can operate in the majority of homes in Ontario regardless of size, structure, or location. The advantages of GHP go far beyond electricity conservation. GHP positively impacts local economies, significantly reduces household C02emissions, result in the most comfortable indoor space conditioning available, and saves the homeowner money. Geothermal systems will continue to compete effectively in Ontario's heating and cooling market without the benefit of government investment in their future. However, organizations such as the OPA have the ability to increase awareness and acceptance of GHP province-wide to ensure that the benefits of geothermal energy are experienced by everyone.

---

[i] Suzuki, David. Smart Generation: Powering Ontario with Renewable Energy, 2005.

[ii] Ibid.

[iii] Ibid.

[iv] IESO Ten Year Outlook: Highlights.
http://www.ieso.ca/imoweb/pubs/media/10yearOutlook-highlights-2005jul.pdf

[v] Ibid.

[vi] Murray Campbell, The Globe and Mail, July 9, 2005.

[vii] National Earth Comfort Program: Geothermal Heat Pump Market Mobilization and

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35 Earl Martin Drive
Elmira, Ontario N3B 3L4
Tel: 1.800.367.9810
Fax: 1.877.684.3112

Technology Demonstration. Geothermal Heat Pump Consortium.

[viii] Suzuki, David. Smart Generation: Powering Ontario with Renewable Energy, 2005.

[ix] Irvine, M. B.Eng. NextEnergy Engineering Department, 2005.

Niagara_Windpower_Supply_Mix_Submission

From: mikefournier [mikefournier@www.niagarawindpower.com]
Sent: August 8, 2005 11:50 AM
To: OPA (Supply Mix Submissions)
Cc: Baker, Sarah (ENERGY); Canada-Ontario Municipal Rural Infrastructure Fund; Canetti, George; Chuck Riddell; David Rodgers; David Suzuki Foundation; deborahpower; George Scott; ION Wire; Janice Emeneau; Jay Shepherd; Jim Rowan; johan de Leeuw; John ; Ken Baigent; Marazzo.T; Mary Roberts; Michelle Beaudoin; Paul Hatorp; Paul Pynn; Paul Zorad; Rob Derks, Maxtower Company Limited; Ron McIntyre; Roy Green; Saeid Izadpanah; Saric, Steve; tmassiah; Tom Marazzo; TRUE-NORTH
Subject: N/A

Attachments: Supply Mix-Grid relief.sxw

Greetings, This is my sugestion

Greeting OPA

Here is my suggestion.

I Call it "GRID-RELIEF"

Re: the proposed power line to Manitoba with a projected of 1.2 Billion Dollars.

Provided it was built on time and on budget, the same money could generate plenty of power another way, by providing an incentive of 20% to home owners and small business.

With a minimum requirement of 2 Kilowatts of installed renewable energy in a mix of small wind and/or solar, a typical installation would cost $20,000.
A 20% grant would equal $4,000.

$1.2 Billion divided by $4,000 per installation would generate 300,000 installations.

300,000 installations @ 2 kilowatts would provide 600.000 kilowatts of electricity or 600 megawatts

300,000 installations X $20,000 per installation would generate $6,000,000,000 worth economic activity

This energy could be in place much sooner than the proposed Manitoba project. The twenty years it would take to pay for the line, also the expense for importating electricity for 20 years is 20 years of money leaving the province.

This new power will not add any grid relief that most local utilities are deading with.

Mike Fournier
Niagara Windpower Inc.

--
Open WebMail Project (http://openwebmail.org)

August 19, 2005

AUG 25 2005

To: Ontario Power Authority
Supply Mix Submissions
175 Bloor St. E, North Tower,
Suite 606
Toronto, ON
M4W 3R8

Re: Supply Mix Submissions

Thank you for the opportunity to comment. This submission will focus on the addition of wind energy to the province's energy supply mix.

The following recommendations will be briefly discussed:

1) Decisions for our future energy needs must be based on well-substantiated, researched and clearly understood facts.

2) The Ministry must ensure that residents and industry have a robust and reliable supply of energy.

3) More funding and better coordination is needed for the implementation of conservation programs.

4) The Ministry must provide incentives and financial aid to citizens and communities for installation of small-scale renewable energy projects.

Reality, foresight, common sense, and most importantly, the courage to make the "right" decisions, are needed now.

BACKGROUND

With this submission, I bring over two years of "on the ground" experience with respect to the province's current wind power initiative. Together with hundreds of local residents, we established the Blue Highlands Citizens Coalition, a local environment group supportive of renewable energy, but concerned about incomplete and uncoordinated provincial polices, especially those concerning wind power. We have taken every opportunity provided by every relevant Ministry to comment on policy development. On a volunteer basis, and without funding, we have collected extensive research materials, which we have shared with our local community, our Councils, and many affected environmental and planning groups. As a result, we have earned both the trust and respect of these groups and individuals, who now look to us for guidance and up-to-date information. We are committed to ensuring that policy solutions for wind energy are well integrated within all Ministries, and implemented in an open and transparent manner.

Unfortunately, after personal meetings with Ministry of Energy policy advisors, and repeated requests to

participate in the development of this renewable power policy initiative, the Ministry continues to move forward with directives based soley on industry information and recommendations. Public consultations with local affected residents have not been forthcoming, nor is there any indication that residents who have no financial interest in wind power development will have a chance to voice their concerns to this Ministry's representatives.

To date, wind industry based marketing and planning policies are promoted by Ministers and policy makers. Blanket statements about the benefits of wind energy can mislead the public, who often are unaware that consideration must be given to the unique local situation that exists in each municipality. The Ministry of Energy must not disregard the importance of public consultations in the development of renewable energy policy. The Ministy must open the lines of communication with the various environment and residents groups who have made it very clear there are problems with this policy. The current state of distrust and anger among the residents of Blue Mountains, Grey Highlands, Prince Edward County, Hockley Valley, and Tiny and Carling Townships demonstrates that this initiative has failed to consider important environmental and economic issues. Delays are certain to occur, and the establishment of wind energy factories in more appropriate locations will be put off even longer.

It is my hope that with this request for comments, that all concerns, not only those of the energy industry, will be considered. With the desire to replace traditional energy sources with thousands of industrial wind turbines, this government is at risk of failing to supply Ontario with a reliable energy supply, and of supporting an industry-led dismantling of our world respected protective planning policies.

****

1) DECISIONS FOR OUR FUTURE ENERGY NEEDS MUST BE BASED ON WELL-SUBSTANTIATED, RESEARCHED AND CLEARLY UNDERSTOOD FACTS

The current supply problems must be addressed for the long term. Quebec has established a reliable and robust energy supply, and is now reaping the financial benefits. Past provincial premiers took a political gamble by implementing a highly unpopular and politically unmotivated energy policy. It appears that they made the right decision and had the courage to see it through. Ontario must implement a similar "tough" and perhaps unpopular policy in order to repair the damage that has been done to our energy system.

The stop-go policies of our former provincial government have put the energy supply in an extremely unstable position. Keeping electricity prices low to ensure political victory is no answer. This government should be commended for raising electricity prices, as it is one positive step toward reducing energy usage. This was a tough and unpopular political decision to make, and the Liberal government has been taken to task over it. But it was the right decision.

It is evident upon review of task force documents and other public records, that industry representatives came forward and promoted the merits of wind power to the former government. The current Liberal government is now throwing full support behind the industy with the establishment of just under 1400MW of renewable energy (a good part of this being wind) by 2007.

The modern day wind turbine is associated with clean and green energy. The numerous photo opportunities taken by both politicians and envrionment groups attests to this fact. The generation of wind power is emission-free, but it is unreliable, and not without significant impacts. If the government is successful in bringing a turbine manufacturer to the province, what then will be the ratio of emissions produced from the manufacture of steel for each turbine in relation to the emission savings gained through the operation of each turbine? This must be factored into the long term equation. Is wind power really "green", if this manufacturing process serves to produce more emissions than are offset by the working turbines? The short term gain of jobs in the manufacturing industry may result in the further deterioration of air quality for the rest of Ontarians. The Ministry must achieve a balance, and not compromise the environment with decisions based on overstated benefits.

It is the responsibility of our elected officials to debunk the myth that traditional energy generating

facilities can be completely replaced by erecting wind turbines throughout the province.

The following statements discuss the true contribution that wind power can make to our energy supply:

"It must be recognized that ...wind power's inherent deficiencies will severely limit its contribution to reliable electricity generation in this province. For example, should the target of the Ontario government to achieve 2700MW of wind power capacity by 2010 be met, the annual electricity generation would be less than that of one of the Bruce-B nuclear units, based on typical annual capacity factors, and, unlike electricity from the Bruce-B, would not be available on a predictable schedule." (J.T. Rogers, PhD - "Options for Coal-Fired Plants in Ontario, 2004 pg. 17) See attached document.

It is a well-known fact that wind power can only produce 25-35% of stated capacity. Based on this, the province of Ontario will add at best, only 800MW, and not the stated 2700MW, to the system by 2010. Can the huge costs to the taxpayer for a mere 3% of our energy needs be justified when conservation can immediately save significantly more energy at very little cost?

Large-scale wind energy systems have two weaknesses : low intensity and intermittency. "The low intensity requires large areas to collect the energy and intermittency means that the energy is not always available when needed." (Rogers pg. 14) The land base of Southern Ontario is not large enough to house the amount of turbines needed to replace a substantial amount of traditional power generation. Turbines must not be placed near residential areas due to health and safety impacts. As David Boileau, president of Westwindeau and Chair of the Select Committee on Alternative Fuels, stated in the Globe and Mail, "the only problem with wind power, is people". Unless the Liberal government is prepared to set up Stalinist-type rural collectives to remove the human barrier to the erection of extensive wind factories, the paucity of suitable land for these machines cannot be ignored. Protected, sensitive and highly scenic areas are also inappropriate locations for turbines, so again, the lack of suitable sites is an important consideration when planning for the future supply mix.

J.H. Kunstler, in his work "The Long Emergency" makes the following observation concerning North America's current energy situation,

"Fossil fuels allowed the human race to operate highly complex systems at gigantic scales. Renewable energy sources are not compatible with those systems and scales. Renewables will not be able to take the place of oil and gas running those systems. The systems themselves will have to go. Even many "environmentalists" and "greens" of our day seem to think that all we have to do is switch inputs. Instead of running all the air conditioners of Houston on oil-or gas-generated electricity, we'll use wind farms, or massive solar arrays; we'll have super-fuel efficient cars and keep on commuting over the interstate highway system. It isn't going to happen. The wish to keep running the same giant systems at gigantic scale using renewable is the heart of our illusions about solar, wind and water power." (pg 131)

Believing that industrial wind energy go a long way toward solving our supply problems is not being realistic.

"People everywhere enjoy believing things that they know are not true. It spares them the ordeal of thinking for themselves and taking responsibility for what they know." (Brooks Atkinson)

A turbine covered landscape will certainly give the impression that the government is taking measures to provide a reliable, sufficient and green supply of electricity. The sight of wind turbines on the horizon will reassure Ontario residents that our energy needs have been looked after, and as a result, they will not be moved to alter their energy consumption habits. People will always take the path of least resistance, and it is easier to believe that the wind energy companies are saving our air and providing us with a reliable energy supply than it is to give up a comfortable lifestyle.

In a chapter entitled, "Aesthetic Guidelines For A Wind Power Future", Paul Gipe advises proponents to "*Keep them spinning* ... When wind turbines are seen spinning, they are *perceived* as functioning, and therefore, beneficial. Observers are quick to forgive the visual intrusion if the wind turbines serve a purpose; and this they can only do when they are spinning." (Wind Power In View - Pasqualetti, Gipe, Righter, 2002 pgs. 185-186)

Should the future of our renewable energy policy be based on perceived solutions or REAL solutions?

Should renewable energy be about making the public "feel good", rather than truly adding to our generation supply? The public must be informed that wind power will never generate a continual supply of energy. The Ministry must prohibit wind factory operators from "pretending" their turbines are producing power by "keeping them spinning".

The policy advisors and energy experts know that wind power is not the only solution to our energy or our air quality problems. It can play a marginal role. Tough policies that implement stringent pollution penalties and work to truly reduce automobile emissions will make a more significant improvement to our air quality than the erection of thousands of turbines. We can no longer afford to delude ourselves and continue to "paper over the cracks" with short term solutions.

As long as decision makers at the Ministry understand and acknowledge the drawbacks of this type of power, and proceed accordingly, there will be a place for industrial wind power in the future supply mix. The government's desire to prop up this new industry financially will be at the expense of installing more reliable forms of power. As writer Murray Campbell stated in the Globe & Mail - "...hardly anyone, apart from the truly fervent, believes that wind powered generation will ever be anything but a niche supply."

Documents and policy recommendations from the industry players reveal a sense of urgency in opening up the market, and the Ministry is under pressure to entrench new policies that are favourable to the expansion of this industry. Can one conclude this urgency stems from the industry's desire to establish itself in Ontario before the limited benefits of its contribution are discoverd? Is this a case of "the emperor has no clothes"?. The Government must be responsible to its electorate, and now must take an extremely cautious approach. The Ministry of Energy must refrain from issuing any more RFPs for large scale wind power projects until the current successful proponents have their installations running, and the impacts and benefits are scrutinized and assessed.

A group of energy experts writing in the CBC sponsored work "Fueling the Future" recommended that the solutions for our energy supply future lay in conservation, research and development, and rebuilding our power infrastructure. The chapter on wind energy, entitled "wind has weak knees", described the drawbacks of investing too much in industrial wind power due to its unreliability and intermittency problems. These are real issues and must not be ignored.

The Report from the Electricity Conservation & Supply Task Force (2003) acknowledges the minimal role wind power can play in our future supply mix:

"Intermittent Generation (wind power) is provided by generators that produce energy only when conditions are suitable for operation. While technology now exists to much better forecast wind power generation, for example, conditions for intermittent generators are not accurately predicted far in advance so longer term scheduling is not possible. Intermittent generators can be valuable as a source of energy for load displacement, but their inherent unpredictability does not allow them to be used for baseload or peaking purposes." (pg. 48)

The province must put aside the desires of special interest groups and refrain from subsidizing more industrial wind factories until better, more reliable energy sources have been put in place. Then, inform the public about both the benefits and shortfalls of wind energy. As the government is committed to "protecting the interests of Ontarians by ensuring a reliable, sustainable and diverse supply of competitively priced power", this Ministry must truly consider the cost/benefit ratio with respect to the continued promotion of an unreliable, intermittent and expensive form of energy.

Too much investment and too much reliance on industrial wind energy can only hinder, not improve, our electrical generation system over the long term.

2) THE MINISTRY MUST ENSURE THAT RESIDENTS AND INDUSTRY HAVE A ROBUST AND RELIABLE SUPPLY OF ENERGY

Premier McGuinty is calling for an east-west energy grid connection. The chances of this coming to fruition are highly unlikely in the near future.

The Ontario government is presently funding the establishment of unreliable and intermittent energy generation facilities without first ensuring a robust and continual supply of electrical generation from more reliable sources. As southern Ontario is the industrial heartland of the country, reliable energy for industry must be a high priority. The high cost of wind energy in Germany has already forced industries to relocate to more affordable locations. (The Economist - June 25/05) High energy costs will force the closure and relocation of many important industries in Ontario. Quebec and other energy stable provinces will become an attractive and cost efficient alternative to Ontario if this policy direction is not altered. Jobs will be lost and other economic sectors will suffer.

3) MORE FUNDING AND BETTER COORDINATION IS NEEDED FOR THE IMPLEMENTATION OF CONSERVATION PROGRAMS

To date, the Ministry has not made any real advancements in the area of energy conservation. The David Suzuki Foundation reported that California reduced its energy needs by 12% (as opposed to the province's proposed 3% from wind) through its promotion and implementation of conservation measures. With direction from provincial coordinators and/or facilitators and accompanying funding and incentives, local municipal councils and residents would rise to the occasion and make a real difference to our dwindling energy supply. One need only look to the Blue Box recycling program to see what people will do when they are given some direction and guidance. Some of our local residents have already instigated renewable energy workshops. With the provincial government not forthcoming with timely and workable programs, they have taken on the responsibility.

The establishment of regional energy conservation centres should be undertaken. The existence and locations of these offices should be well promoted through an advertising program, and visits from provincial conservation representatives to local Councils should commence. The local government can then implement conservation programs with the help of volunteers appointed to a conservation committee or task force. This committee can then become visible in the community and educate residents and businesses about conservation measures.

As everyone knows, the best way to move people into action is the "carrot and stick" method. More rewards must be given for lower energy use, and energy gluttons should be penalized with stiff fines and high prices. The government must work with the consumer product industry and provide more monetary incentives for the purchase of low energy appliances, funding to manufacturers for retrofitting or new production of daily use machines with timers etc. This will allow a shift to usage during off-peak hours. Residents, businesses and industries must be encouraged to conserve: making a real difference on a voluntary basis is unlikely to happen. Once there is a financial gain or savings to be had, however, conserving energy will become a daily habit, not, for example, a one time desperate measure during a heat wave. Set standards for office air conditioning temperatures. Give significant rebates on the purchase of fans instead of air conditioners. The possibilities are endless.

The low cost of energy conservation makes it a more pragmatic solution to our energy supply needs when compared to industrial scale wind energy.

4) THE MINISTRY MUST ESTABLISH FINANCIAL INCENTIVES AND AID FOR RESIDENTS AND COMMUNITIES TO ERECT SMALL SCALE RENEWABLE ENERGY SYSTEMS

Again, this is the "carrot and stick" method. Rural communities are abuzz with talk of "going off the grid" and becoming energy independent. It is both possible and desirable for farmers and rural landowners to install small scale wind turbines, and/or wind solar energy combinations. The costs, however can range from $30-100,000 depending on the type of system installed.

The government's move toward permitting "net metering" is a positive step, and will encourage more small scale green energy. The ability of a farmer or resident to sell excess electricity back into the grid is

certain to encourage more investment into these smaller renewable energy systems.

The government should establish a development fund for small scale energy home and business renewable systems. The agency should direct residents to the Canadian Wind Energy Association to obtain supplier information. The Ministry of Natural Resources has completed the wind mapping for the province, which is available to anyone at no cost. With an increase in demand, the price of these systems should decrease, and at the same time, the small scale energy supply industry will continue to grow and provide profit and employment for more entrepreneurs in the province.

Financial institutions can also participate by providing low interest rate loans for home energy systems. Low rates would move people to obtain financing for the installation costs. Many banks provide funding for environmental causes already, so this would not be out of their realm of interest, and the public relations benefits could be quite significant.

While the erection of small scale private and community based renewable energy projects is both desirable and attainable, much work needs to be done with respect to siting recommendations and the education of planning staff and local Councils throughout the province. Wind power proponents have presented self-serving planning documents that fail to consider the unique environmental and economic aspects of each municipality. Until this education is undertaken with the guidance of a committee that includes a number of residents and non-industry experts, local municipal councils will be put in a state of constant planning chaos. The option of leaving planning policy development to wind power proponents is a conflict of interest and must be avoided. Although planning responsibilities are the jurisdiction of the Ministry of Affairs and Housing, the fact remains that the push for renewable energy is a Ministry of Energy initiative. Therefore, it is up to this Ministry to integrate proper and fair policies in conjunction with other relevant Ministries.

Recommendations found in Ontario Sustainable Association's "Powering Ontario Communities: Proposed Policy for Projects up to 10MW", fail to address the above information and education vacuum. Although it is suggested that the first step should be to discuss this program with other related Ministries, the Association wants the program to commence in 90 days. This is an unworkable and undemocratic time frame. Over the last 2 years, it has become clear that most other related Minstries are far behind in their policy development with respect to wind power. This leads one to question how responsible the urgent implementation of this policy is, considering the fact that policy foundations have not yet been established.

Mr. Gipe etal also state that they believe sufficient stakeholder consultation has already been undertaken, although they do consider that the final decision in this regard is up to the Ministry. Residents groups, the Niagara Escarpment Commission, CONE, Ontario Nature (FON), and other affected and important stakeholders have not been consulted. The issues of inappropriate siting and preclusion of regions has not been addressed. OSEA has made it clear that the most important input will come generally from the renewable energy industry. This recommendation clearly means to override the government's stated goal of more public participation.

In the 2002 study, "Wind Power In View", a study to which Mr. Gipe contributed, it states: "Like the robber barons of the 19th century, (some leaders of the American wind industry) view public resources only for the private taking. It is this disregard of their social and environmental obligations that has cost the U.S. wind industry, especially in California, so dearly. Good neighbours, which wind companies have not always been, carefully consider how their private acts affect those around them. Good neighbours do not pound their fists on the boardroom table and declare "the public be damned"." (pg 180) It is imperative to learn from, and to not repeat the mistakes of the past.

CONCLUSION

THIS GOVERNMENT MUST ENSURE THAT IN ITS PURSUIT TO PROVIDE A VARIETY OF FORMS OF ENERGY GENERATION FOR FUTURE SUPPLY, IT DOES NOT COMPROMISE THE QUALITY OF LIFE OF THE CITIZENS OF THIS PROVINCE OVER THE LONG TERM

The Ministry of Energy must take more control over the regulation and monitoring of wind energy proponents. Only then can the establishment of the wind energy industry proceed in an transparent, fair, and respectful manner. Unfortunately, some wind energy proponents already have tarnished the reputation of the industry by not following best practices, and by not, as Mr. Gipe states above, carefully considering how their acts affect local residents, their communities, and their environment.

I urge this Ministry to take two steps back, and spend quality time evaluating the events of the past two years. Mistakes have already been made, however, it is not to late too take stock of the situation, and bring the affected Ministries and the public to the table. This is the only way to ensure that a proper planning foundation is put in place, one that is consistent with the Niagara Escarpment Planning and Development Act, the Oak Ridges Moraine Conservation Plan, and the newly passed Greenbelt Act. The existence of these protected regions are integral to the quality of life of Ontarians. They must remain unchanged and undeveloped for future generations.

It is my hope that the Ministry initiate public consultations as soon as possible. Thank you for considering these comments, and we are ready to help the Ministry in the continued development of this renewable energy policy.

Sincerely,

Dawn Nichols

Dawn Nichols
RR#2
Singhampton, ON
N0C 1M0
519-922-2510
dawnandbrad@sympatico.ca

OPTIONS FOR COAL-FIRED POWER PLANTS IN ONTARIO

J.T.ROGERS, PhD

Professor-Emeritus

Department of Mechanical and Aerospace Engineering

Carleton University

Ottawa, Ontario

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OPTIONS FOR COAL-FIRED POWER PLANTS IN ONTARIO

J.T.ROGERS, PhD
Professor-Emeritus
Dept. of Mechanical and Aerospace Engineering
Carleton University
Ottawa, Ontario

1.0 INTRODUCTION

The Ontario Government has announced its intention to phase out the burning of coal for electricity production in Ontario by 2007 because of the resulting air pollution [1]. Coal-fired power plants, with an installed capacity of 7578 MW, supplied 36.2 TWh of electricity in 2003 [2], about 23% of Ontario's electricity [1]. Therefore, the expressed intention of the Government presents a major challenge - to avoid an electricity supply shortfall caused by taking the coal-fired power plants out of service. The challenge includes not only the replacement of the coal-fired plants but the accommodation of the forecast increase in electricity demand in Ontario of almost 9%, on a median-growth basis, from 155.1 TWh in 2003 to 168.9 TWh in 2014 and a growth in peak demand, the key to capacity needs, of about 10%, from about 24,100 MW to about 26,600 MW, over the same period [3]. The purpose of this paper is to consider options to meet this challenge. It is well beyond the scope of this paper to undertake an economic analysis of these options, but the need to take into account cost-benefit assessments in evaluating options is emphasized.

2.0 COAL-FIRED POWER PLANTS IN ONTARIO

2.1 Ontario Power Plants and Air Pollution

There are five coal-fired power plants in Ontario, as shown in Table 1, which gives data for 2003 [2], all operated by Ontario Power Generation (OPG). These plants are significant contributors to air pollution in Ontario, as discussed below in section 2.2. OPG also operates a large fossil-fuel plant, Lennox, which uses both oil and natural gas to generate electricity. As shown in Table 1, this plant typically generates only about 7% of the total OPG fossil fuel plant electricity generated in Ontario [2, 4], so that its contribution to air pollution is relatively minor, especially when burning natural gas which is used for about 70% of its generation. Electricity generated in nuclear (40% in 2003 [1]) and hydro (22% in 2003 [1]) plants in Ontario produces essentially no air pollution. A small percentage of electricity in Ontario is generated by Independent Power Producers (IPP) and by certain industries using natural-gas fired plants, small hydro plants and waste-fired (e.g., pulp waste) plants [4], making a minor contribution to air pollution in the province.

The annual capacity factors (ACF) for 2003 for the coal-fired plants given in Table 1 indicate that these plants are used mainly for intermediate-load service[1]. Nevertheless, some of these plants, particularly Nanticoke and Lambton, have been used in recent years partly in base-load service to compensate for the loss of base-load capacity resulting from the lay-up for refurbishment of the Pickering-A and Bruce-A nuclear units [4]. With the return to service of Bruce units 3 and 4 and Pickering unit 4 in 2003 and the recently announced intention of OPG to refurbish and return to service Pickering unit 1, as recommended by the OPG Review Committee [5], the need for the coal-plants to act as base-load plants will be reduced, thus reducing emissions of air pollutants.

The Lakeview plant, scheduled for shutdown in 2005, now plays an important role because of its proximity to Toronto by supporting system reliability and providing reactive support to maintain local voltages [4]. The Thunder Bay and Atikokan plants provide local generation in Northern Ontario for voltage support and transmission security [4]. See reference [6] for a discussion of the need to maintain voltage support in transmission systems.

TABLE 1

ONTARIO POWER GENERATION FOSSIL FUEL POWER PLANTS

Data for 2003 [2] ACF: Annual Capacity Factor, %

Station	Fuel	No. of Units	Capacity, MW	Energy, TWh	ACF, 2003	Dates In Service	Original Retirement Date
Nanticoke	Coal	8	3938	20.4	59.1	1973/1978	2015
Lambton	Coal	4	1975	10.6	61.2	1969/1970	2010-2020
Lakeview	Coal	4	1140	2.8	28.0	1962/1969	2005
Thunder Bay	Coal	2	310	1.5	55.2	1981/1982	2021
Atikokan	Coal	1	215	0.9	47.8	1985	2025
TOTAL	Coal	19	7578	36.2	54.3		
Lennox	Oil/Gas	4	2140	2.8	14.9	1976/1977	2016

2.2 Emissions of Air Pollutants

The key air pollutants in Ontario are nitrogen oxides (NO_x), sulfur dioxide (SO_2), fine (respirable) particulate matter, PM, volatile organic compounds (VOC), carbon monoxide and mercury [7, 8]. Both NO_x and VOC lead to the formation of ozone, one major component of smog, while particulate matter is the other major component. Smog and SO_2 can irritate the lungs and lower one's resistance to respiratory infection as well as aggravating cardio-vascular

[1] Base Load: capacity required to meet relatively constant demand, i.e. the minimum demand on a utility. Peak Load: capacity required to meet intermittent high demands. Intermediate Load: capacity required above base but below peak demands, e.g., capacity needed during the day, but not at night, or during the week, but not on weekends.

disease. Mercury can cause cancer and reproductive and developmental effects; the main concern with mercury is that it can accumulate in the food chain, causing exposures significantly higher than those directly from the air [8]. The main source of carbon monoxide, which is fatal in high concentrations, is incomplete combustion in vehicles and other transportation sources [8].

The Ontario Medical Association (OMA) has estimated that approximately 1,900 premature deaths in the year 2000 may be attributed to the effects of air pollution in Ontario. Also, the OMA has estimated that, annually, about 9,800 people are admitted to hospital and some 13,000 people make emergency room visits due to the effects of air pollution in Ontario [7].

In addition to negative health effects, NO_x and SO_2 cause acid rain which can damage lakes, vegetation and structures [8].

Of the total production of the most significant of these air pollutants in Ontario in 2000, OPG fossil-fuel power plants produced about 14.7% of the NO_x, 23.7 % of the SO_2 , 22.6% of the mercury and essentially none of the VOC and carbon monoxide [8]. (Information on the percentage of fine particulate matter produced from fossil-fuel power plants in Ontario is not provided in reference 8) Thus, phasing out of the coal-fired power plants will certainly not eliminate these air pollutants in Ontario, particularly since about 50% of air pollution in Ontario comes from sources in the US mid-west, including coal-fired plants which contribute a much larger percentage of electricity in that region than coal-fired plants do in Ontario [7, 8]. This fact should be taken into account in examining options for the coal-fired plants in Ontario.

The issue of the emission of CO_2, a greenhouse gas, from the coal-fired plants is not addressed in this paper, since CO_2 , as a natural constituent of the atmosphere, does not contribute to the negative health effects of the emissions which are the primary cause of the decision to shutdown the coal-fired plants.

2.3 Possible Options to Reduce Air Pollution from Coal-Fired Plants

As pointed out in section 1.0, simply shutting down the coal-fired plants in Ontario by 2007 to reduce air pollution without taking any other action is not really an acceptable option. Nevertheless, there are a number of options that could reduce air pollution from coal-fired power plants in Ontario. These options comprise:

- Improve emission controls in the coal-fired plants,
- Convert the coal-fired plants to burn natural gas or build new gas-fired plants to replace the coal-fired plants,
- Replace at least some of the coal-fired generation by new renewable (alternative) energy sources,
- Reduce need for the coal-fired plants by greater importation of electricity,

- Replace the coal-fired plants by nuclear plants.

It should be recognized that the Manley Report [5], suggested that the Ontario government should consider improving emission controls on some of the coal-fired plants and converting others to gas firing as options to shutting them down. However, the Report did not make a recommendation to this effect.

Conservation, including the use of more efficient electrical systems and appliances, the adoption of time-of-use metering [3] and what is more properly termed improvement in the effectiveness of energy use [9], can delay the need for adding additional capacity by reducing the growth of electricity demand with any of these options. However, the 10-year forecast by the Independent Electricity Market Operator (IMO) already takes into account the effects of projected conservation, based on recent and proposed actions, on the growth rate of electricity demand in Ontario [3]. Thus, conservation alone is not really a separate option for reduction of air pollution from coal-fired plants in Ontario, although it will assist all of the options by reducing demand to some extent. See section 4.0 for a discussion of an initiative of the Ontario Ministry of Energy in this area.

In assessing these options, their costs of implementation and other factors should be taken into account as well as their benefits in the reduction of adverse health effects. An effective approach for doing so is the application of the ALARA and "De Minimis" principles as applied in the regulation of nuclear activities in Canada and elsewhere [10, 11]. The ALARA (As Low as Reasonably Achievable) principle means that economic and social factors are to be taken into account in setting limits for risk or exposure to adverse health effects on a societal basis, while ensuring that individuals are protected by specific legal requirements. The "De Minimis" principle states that risks of an activity need not be reduced below a level that is generally accepted as being of no significance to an individual or to a society. That is, risks need not be reduced below a level at which efforts to control the sources of risks would constitute an undue expenditure of societal resources for an insignificant benefit in health protection.

The following sections discuss the above-listed options and draw certain conclusions.

3.0 IMPROVEMENT OF EMISSION CONTROLS AT COAL-FIRED POWER PLANTS

Emissions of air pollutants from coal-fired power plants can be significantly reduced by the application of emission control devices and procedures.

Emissions of NO_x can be reduced by:

- improved combustion processes (low NO_x burners, fluidized-bed combustion) that lower combustion temperatures to minimize NO_x formation [12],

- computer controls of the combustion process (CCC) to minimize NO_x formation,
- the application of Selective Catalytic Reducers (SCR) to remove NO_x from flue gases,

Emissions of SO_2 can be reduced by:

- burning low-sulfur coal to reduce SO_2 formation,
- the application of Flue Gas Desulfurizers (FGD) using wet limestone scrubbing to remove SO_2 from flue gases [12],
- fluidized-bed combustion using limestone injection to remove SO_2 during combustion [12].

Emissions of particulate matter can be reduced by:

- burning low-ash coal to reduce PM formation,
- the application of Electrostatic Precipitators to remove PM from flue gases [12],
- the application of bag-house filters to remove PM from flue gases.

There is no technology currently in place for the removal of mercury from power plant emissions, although bag-house filters apparently can do so to some extent, as well as removing particulate matter [13]. However, it should be noted that a recent study has shown that mercury in soils in the USA (and its subsequent accumulation in the food chain) cannot be attributed to deposition from air of mercury emissions from fossil fuel plants and other human activities [14], so that the need to remove mercury from power plant emissions may not be as urgent as currently believed.

At one time, particularly in the UK, tall stacks at fossil-fuel power plants were considered an adequate means of controlling human exposure to air pollutants from these plants. However tall stacks obviously do not reduce air-pollutant emissions but simply reduce ground-level concentrations by dispersing the pollutants widely [12].

Emission control devices installed and procedures used at the OPG coal-fired plants are listed in Table 2. Electrostatic precipitators and low-sulfur coal are in use in all of the units at all five OPG coal-fired power plants and computer combustion controls and low NO_x burners are in use in all of the units at the three large plants. Flue gas desulfurizers are installed in only two units at the Lambton plant and selective catalytic reducers, which have just come into operation this summer, are installed in only two of the eight units at the Nanticoke and Lambton plants.

TABLE 2

EMISSION CONTROL DEVICES AND PROCEDURES AT OPG COAL-FIRED PLANTS

Information from References 2, 4, 13, 15

Plant & Total Units	Elect. Precip.	Low S Coal	CCC	Low NO_x Burners	FGD	SCR
Nanticoke/8	8 units	8 units	8 units	8 units	None	2 units
Lambton/8	8 units	8 units	8 units	8 units	2 units	2 units
Lakeview/4	2 units	4 units	4 units	4 units	None	None
Thunder Bay/2	2 units	2 units	None	None	None	None
Atikokan/1	1 unit	1 unit	None	1 unit	None	None

Nevertheless, the use of electrostatic precipitators, low sulfur coal, combustion computer control and low NO_x burners at the three large coal-fired stations and the use of electrostatic precipitators and low sulfur coal at the two small stations plus low NO_x burners at Atikokan have reduced emissions from previous levels. Total emissions from these plants have been reduced considerably since the early 1980s with NO_x emissions being reduced by about 36% from 1983 to 1999 [4] and about a further 23% from 1999 to 2003 [2] and with SO_2 emissions being reduced by about 68% from 1983 to 1999 [4], although increasing somewhat since then [4]. Under 1999 Ontario regulations, OPG must meet annual aggregate caps of 60 Gg of NO_x emissions and 175 Gg of SO_2 emissions from its fossil-fuel stations, including Lennox and , under additional 2001 regulations, OPG has been limited to 35 Gg of NO_x and 153.5 Gg of SO_2 emissions in 2002 and 2003 [2].

As indicated in Table 2, further reductions in emissions of NO_x and SO_2 from OPG's coal-fired stations would be possible by the installation of SCRs and FGDs at those units now without them. For example, the installation of SCRs at the six units without them at Nanticoke would reduce specific NO_x emissions[2] from 1.50 kg/MWh to 0.37 kg/MWh [13] and the installation of FGDs at all 8 units would reduce specific SO_2 emissions from 4.15 kg/MWh to 0.77 kg/MWh [13]. Assuming an annual capacity factor of 65%, as in reference 13, and assuming that the specific emission coefficients for units with and without SCRs and FGDs for Nanticoke apply also at Lambton, the annual emissions of NO_x and SO_2 from Nanticoke and Lambton and the total from both stations are shown in Table 3. The installation of FGDs would also help to reduce PM emissions and the installation of baghouse filters would further reduce PM emissions [13].

[2] Evaluated as NO_2

TABLE 3

NO_X AND SO_2 EMISSIONS AT NANTICOKE AND LAMBTON STATIONS

Assumed Annual Capacity Factor = 65%

	NO_x, Gg/a Current	NO_x, Gg/a 8 SCRs	SO_2, Gg/a Current	SO_2, Gg/a 8 FGDs
Nanticoke	33.6	8.3	93.1	17.3
Lambton	16.9	4.2	37.1	8.7
Total	50.5	12.5	130.2	26.0

Table 3 shows that the application of SCRs and FGDs to all the units at Nanticoke and Lambton would reduce the total emissions of NO_x and SO_2 to about 12.5 and 26 Gg per year, which would contribute significantly to ensuring that total OPG emissions would be kept well below the aggregate caps specified by current Ontario regulations.

From the experience of installing the existing SCRs at Nanticoke and Lambton and the existing FGDs at Lambton, it appears that it would be possible to complete the installation of SCRs and FGDs at these stations by the end of 2007, if the commitment to do so were made now.

However, the cost effectiveness of such steps compared to other options must be assessed. For example, the installation of SCRs at two units at Nanticoke and two units at Lambton cost approximately $262 million [2] and the installation of two FGDs at Lambton in the mid 1990s cost about $500 million [2], so that the installation of these technologies at the remaining units at Nanticoke and Lambton would involve expenditures of the order of $4.3 billion. A somewhat lower expenditure estimate, $3.0 billion, for such an installation results from data provided in reference 13. These rough estimates should be compared to the costs of other options discussed later. In doing so it should be recognized that closing the coal-fired plants in 2007 will result in a write-off of valuable assets, considering the original retirement dates shown in Table 1. OPG has already shown a debit of $576 million in its 2003 financial statements to account for this loss of assets [2].

4.0 REPLACEMENT OF COAL-FIRED GENERATION BY NATURAL GAS-FIRED GENERATION

4.1 Current Commitments and Plans

OPG is a partner, together with ATCO Power Canada and ATCO Resources, in the Brighton Beach Venture: a 580 MW combined-cycle gas turbine (CCGT) plant burning natural gas, located at the old J.C.Keith power plant site near Windsor, Ontario [1]. Construction began in 2002 and the plant is scheduled to be in service in the summer of 2004, at a projected capital cost of $403 million, or about $700/kW, which is now expected to be exceeded [1].

OPG is also a partner, with TransCanada Energy Ltd, in the Portlands Energy Centre Venture, the assessment of the viability of a natural-gas fuelled energy centre in the port area of downtown Toronto. The Centre would comprise a 550 MW combined-cycle gas turbine facility and a co-generation facility which would provide steam for district heating [1]. An Environmental Review report was submitted to the Ministry of Environment in November, 2003 [1].

Assuming that the Portlands Energy Centre materializes, these ventures would provide about 1130 MW of capacity which would be in service before 2007, offsetting about 15% of the coal-fired capacity to be phased out by that date. While this capacity is just about equal to that of the Lakeview plant near Toronto it would not be available next year, when the Lakeview plant is scheduled for shutdown. Nevertheless, the locations of these plants, in Toronto and Windsor, meets an important requirement of the Independent Electricity Market Operator since, with few exceptions, replacement capacity must be located in same general area as the plant being closed, as well as having similar operating characteristics, to avoid system operability and transmission inadequacy problems [3]. See section 4.3 for further discussion of the Lakeview plant.

Finally, a small addition to Ontario capacity is being built by Northlands Power, a 25 MW gas-fired plant near Kirkland Lake [3].

4.2 Ontario Ministry of Energy Initiative

In partial response to the need to find replacements for the coal-fired plants that are to be phased out by 2007, the Ontario Ministry of Energy (OME) has issued a request for qualifications and interests to provide 2500 MW of new "clean" generation capacity or demand reduction measures [16, 17]. Based on responses to this request, a request for proposals (RFP) will be issued by about the end of September, 2004.

To be eligible under this RFP, proposals for new capacity, for either base, intermediate or peak generation, must:

- have a capacity of 5 MW or greater,
- not burn coal or oil as a fuel,
- not be an upgrade or expansion of an existing generating facility,
- be located in Ontario,
- be in commercial operation no later than June 1, 2009.

It is somewhat surprising to note that the date for the start of commercial operation is June 1, 2009. The RFP is implicitly recognizing that the target date for the shut down of the coal plants of the end of 2007 will not be met.

The new capacity may be connected to the IMO grid, to a local distribution network or supply electricity directly to the user. Note that there is no requirement that a proposed new plant must be located in the same general area as one of the plants to be closed, contrary to the preference

of the IMO, as stated above in section 4.1. This requirement is particularly important for the planned closure of the Atikokan and Thunder Bay coal-fired plants, which play important roles in providing generation in the north-western part of Ontario.

While small hydro developments would be eligible under this RFP[3], it is probable that most proposals would be for natural-gas fired capacity, as implied in reference 17. The RFP document also states that proposed facilities should be suitable for intermediate-load service, as were the coal-fired plants historically, and should be capable of cycling on and off overnight and of ramping to meet load changes. The RFP document also states that proposals for facilities for peaking service are unlikely to be accepted. In addition, a condition of the RFP for a specified heat rate[4] for the proposed facilities of 7500 BTU/kWh (7912 kJ/kWh), or a thermodynamic efficiency of 45.5%, will essentially limit them to combined-cycle gas turbines or CCGTs plus co-generation plants, effectively excluding lower-efficiency plants such as steam plants burning natural gas or simple-cycle gas turbines

Requirements are also specified for proposals for demand reduction measures, including a requirement to be in effect by the end of 2007.

If the objective of this RFP is met, about one-third of the current coal-fired capacity would be replaced by new capacity or demand reduction measures within the period between the end of 2007 and June 1, 2009. Thus, other measures would still be necessary to enable the phase-out of all OPG coal-fired plants by the target dates.

4.3 Conversion of Coal-Fired Plants to Natural Gas

The requirement that a proposed facility under the Ontario Ministry of Energy RFP not be an upgrade or extension of an existing facility appears to rule out consideration of converting the existing coal-fired plants to natural-gas firing. However, such conversions certainly should be considered as a means of ensuring that replacements are in service when the coal-fired capacity is phased out.

It appears that the only really practical means of converting to natural gas fuel would be to modify the furnace of a coal-fired unit to burn natural gas instead of coal to produce steam in its steam generators. While this step would result in relatively low thermodynamic efficiency, about 30%, or a heat rate of about 12,000 kJ/kWh, it would enable most of the components of the coal-fired plant to be retained, with only the scrapping of the coal and ash handling equipment being required, and their replacement by gas burners and any needed modifications to the furnaces. Conversion of the coal-fired plants to simple-cycle or combined-cycle gas turbine plants would involve scrapping most of the existing components at the plants and replacing them with the appropriate components for the gas-turbine cycles. It appears that it

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[3] The Ontario Ministry of Energy has also issued a request for expressions of interest for the provision of 300 MW of renewable energy capacity [16, 17, 18], as discussed in section 5.0 of this paper.

[4] The heat rate is the ratio of energy provided by the fuel to the kilowatt-hour electrical output, expressed in terms of BTU/kWh or kJ/kWh. Accounting for proper units, the heat rate is inversely proportional to the thermodynamic cycle efficiency.

would be more practical to build entirely new gas-turbine plants to replace the existing coal-fired plants rather than converting them..

The Nanticoke Conversion Study of 2001 provides information on the possibility of building of a combined-cycle gas turbine plant to replace the Nanticoke coal-burning plant [13]. The estimated capital cost of a CCGT plant plus gas pipeline connections is about $814/kW in 2001 Canadian dollars for a total capital cost for the replacement plant of $3.20 billion. The study also found that the present value of the capital cost of a CCGT for Nanticoke and of operating it to 2030 would be about $5.3 billion greater than the present value of the current Nanticoke with SCRs, FGDs and baghouse filters installed on every unit and operating the plant to the same year [13].

While conversion of all the present coal-fired capacity to more efficient simple or combined cycle gas turbines may not be very practical, for the reasons given above, the Lakeview plant presents a special case for the simpler conversion to gas firing of its furnaces. As mentioned in section 2.1, the 1140 MW Lakeview plant, scheduled to be closed in 2005, plays an important role in maintaining system reliability and sustaining local voltages by its proximity to Toronto. To enable Lakeview to continue to fulfill these important functions, its conversion to the burning of gas to generate steam for its turbines, at a heat rate of about 12,000 kJ/kWh compared to a typical current heat rate of about 10,800 kJ/kWh [4], might be worth consideration, rather than simply closing it next year[5].

4.4 Natural Gas Availability and Cost Issues

Replacement of coal-fired generation by gas-fired generation in Ontario, raises at least two issues of importance: the supply of natural gas for this purpose and the effect of long-term natural gas costs on electricity costs. These issues are discussed in this section of this paper.

4.4.1 Natural Gas Availability

An upper limit to the increased demand for natural gas in Ontario can be estimated by assuming that all the OPG coal-fired plants would be converted to, or replaced by, gas-fired plants and by making certain additional assumptions. As stated earlier, the coal-fired plants have been and are mainly used for intermediate-load service and it can be assumed that gas-fired plants will also be used for such service, as indicated by the RFP of the OME described in section 4.2. Therefore, assume that the gas-fired plants would operate at an average annual capacity factor of 60%.

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[5] The Independent Electricity Market Operator had directed OPG to retain the option to convert two of the Lakeview units to synchronous condenser operation [3] but this directive was later rescinded. See reference [6] for information on this role.

As discussed in section 4.3, coal-fired plants could be converted to gas-fired plants or the coal-fired plants could be replaced by simple-cycle gas turbines or combined-cycle gas turbines[6]. Typical thermodynamic cycle efficiencies (heat rates) for these plants are:

- Gas-fired steam plants: 30% (HR:12,000 kJ/kWh)
- Simple-cycle gas turbine plants [19]: 30% to 35% (HR: 12,000 to 10,286 kJ/kWh)
- Combined-cycle gas turbine plants[19]: 45% to 50% (HR: 8,000 to 7,200 kJ/kWh)

Choosing an average cycle efficiency of 40%, or a heat rate of 9000 kJ/kWh, with the assumed annual capacity factor of 60%, and based on the thermodynamic properties of methane, the quantity of natural gas required to replace all the OPG coal-fired plants with gas-fired plants would be about 9.82×10^9 cubic metres, or 347 billion cubic feet (Bcf), per year. The total primary demand for natural gas in Ontario in recent years has averaged about 986 Bcf /yr [21, 22]. Therefore, to replace all the OPG coal-fired plants with natural gas-fired plants would require an increase of Ontario's primary demand for natural gas by about 35%, all by pipeline from Alberta. TransCanada's Canadian Mainline design capacity to Ontario is now about 1370 Bcf/yr [23] so that an excess capacity of about 384 Bcf/yr exists now. Therefore, converting all of the OPG coal-fired plants to natural gas would require almost all of this excess capacity.

Although complete replacement of the OPG coal-fired plants by gas-fired plants by the target date of 2007 (or even 2009) may not be realistic, partial replacement is certainly possible. The quantities of natural gas required to meet the needs of the cases discussed in section 4.3 can be estimated by making assumptions about annual capacity factor and heat rate appropriate to the particular case. The results are shown in Table 4, together with the above estimate for complete replacement of coal-fired generation by natural gas-fired generation. For the Ontario Ministry of Energy RFP case, it is assumed that 80% the total 2500 MW of new capacity or demand reduction is met by gas-fired projects.

For the committed or planned cases discussed in section 4.3, cases 1 to 4, Table 4 shows that the total additional annual natural gas requirements would be 114.5 Bcf/yr, or about 12.6 % of Ontario's present primary demand. This still represents a significant increase of natural gas demand over the next few years, on top of increasing demands for other uses. Table 4 also shows the additional incremental and total gas supplies needed should the Nanticoke and Lakeview conversions discussed above be implemented so as to ensure that all of the present coal-fired capacity is replaced by natural gas-fired capacity as well as to allow for some growth in intermediate load in the next five years. The resulting total gas requirements would be 339.7 Bcf/yr, or again about 35% of the present Ontario consumption. It is not clear that such an increase in capacity over the next three years, or even five years, could be realistically accommodated in the existing gas transmission system. Considering the forecast increase of demand for natural gas for all purposes in Ontario in the next few years [24], additional

[6] Cogeneration plants that combine electricity production with the provision of heat for industrial, district heating or other industrial purposes are very effective in their employment of energy [9, 20] and are sometimes credited with high cycle efficiencies (low heat rates) because of this [17]. However, this high efficiency, or low heat rate, does not apply to their electricity generation function and therefore is not relevant for this analysis.

pipeline capacity would be needed much sooner than previously anticipated if the OPG coal-fired plants are to be converted to gas by the end of 2007, the desired date for closing down the coal-fired stations, or even by June 1, 2009, as implied by the OME RFP.

TABLE 4

NATURAL GAS REQUIREMENTS AND COSTS FOR VARIOUS GAS-FIRED GENERATION CASES FOR ONTARIO

Case		Capacity, MW	Assumed ACF, %	Assumed Heat Rate, kJ/kWh	Gas Required Bcf/a	Gas Required % Ontario Present Total	Gas UEC, Cents/kWh	Annual Gas Cost, $ Billions
	Total Capacity	7578	60	9,000	347	35.2	4.95	1.97
1	Brighton Beach	580	60	6,500	19.2	2.0	3.58	0.109
2	Portlands	550	60	6,500	18.2	1.8	3.58	0.103
3	Northlands	25	60	6,500	0.83	0.08	3.58	0.005
4	OME RFP	2000 [7]	60	7,500	76.3	8.7	4.13	0.434
	Total, 1 to 4	3155			114.5	12.6		0.651
5	Lakeview Conversion	1140	60	12,000	69.6	7.0	6.60	0.395
6	Nanticoke Conversion to CCGT	3920	65	7,200	155.6 [8]	15.7	3.96	0.884
Total, 1 to 6		8340			339.7	35.3		1.93

In addition to the issue of pipeline constraints to large increases in gas supply in the short term, there is the longer-term issue of adequate gas supply over the lifetime of the gas-fired plants. Although the production rate of natural gas from conventional sources in western Canada is flat at this time, in spite of significant drilling, projections indicate that the availability of natural gas in Canada from all sources, including gas from the Arctic, the east coast and liquefied natural gas imports, will increase in the future [24]. However, there will be increasing

[7] Assuming 80% of OME RFP proposals will be for natural gas-fired plants.
[8] According to The Nanticoke Conversion Study, the gas requirement for the CCGT plant would be 162 PJ/a [13]. For a gas heating value of 1000 BTU/cf [13], this is equivalent to 153.6 Bcf/a, in excellent agreement with the present estimate.

demands for gas exports, for oil-sands recovery and upgrading and other purposes [24], which could jeopardize the reliable supply of gas for electricity generation in Ontario.

4.4.2 Natural Gas Cost

Replacement of coal-fired generation in Ontario by gas-fired generation will increase significantly the unit energy costs of electricity and the total annual fuel costs for these plants . Current natural gas prices in Canada are about $7/GJ [24, 25] and natural gas prices are expected to average somewhat above $5/GJ for the next ten years [24]. Assuming an average gas cost of $5.50/GJ and the heat rates given in Table 4, the current gas unit energy cost (UEC) in cents per kilowatt hour for the cases considered in section 4.4.1 can be calculated and are also given in Table 4. From this value, the total annual current cost of gas for these cases can also be calculated for the given capacities and capacity factors, as also given in Table 4.

Thus, the replacement of coal-fired generation by the committed or planned natural gas fired generation would increase fuel costs for these plants by a factor of about 2.5. Also, it should be noted that the fuel UEC for the committed or planned gas-fired generation, about 3.6 to 4.1 cents/kWh, is a significant fraction of the capped price of electricity for low-volume residential and other designated users in Ontario of 4.7 cents/kWh [26], meaning that this electricity will most probably be sold at a loss, once other operating and maintenance costs as well as capital-costs recovery are taken into account. Considering the increased future demands for natural gas as mentioned in section 4.4.1, there could very well be significant price increases and volatility even with the additional sources of supply. Thus, the costs of electricity from gas-fired power plants in Ontario could be even higher than estimated here

For comparison, assuming a current coal cost in Ontario of about $46 per tonne [13], assuming a higher heating value of 12,000 Btu/lb (27,900 kJ/kg) for the coal, the present UEC and total annual cost for the OPG coal plants can be calculated to be about 1.49 cents/kWh and about $0.60 billion, respectively. .

5.0 REPLACEMENT OF COAL-FIRED GENERATION BY NEW RENEWABLE (ALTERNATIVE) ENERGY SOURCES

5.1 Current Situation

First of all, the meaning of "renewable energy sources" must be clarified. The Ontario Ministry of Energy RFP effectively excludes large-scale hydro power plants [17], which provided about 37,000 GWh, or about 23%, of electricity in Ontario in 2003 [27]. In any case, there are no remaining large-scale hydro sites in Ontario that can be readily developed economically, although the Ontario Water Power association estimates that a potential of 1200 MW to 4000 MW of hydro capacity could perhaps be added [1]. Only small hydro plants, 100 MW or less, are considered "renewable energy sources" for the present purposes [17]. Thus, a more appropriate term, "alternative energy sources", is often used.

Nevertheless, a limited expansion of conventional hydro power has been committed in Ontario. The construction of an additional water tunnel at the Adam Beck hydro plant on the Niagara river will add about 200 MW capacity and provide about 1.6 TWh per year of electricity[9] [28]. However, this expansion will take about 4 ½ years to complete and so will not be available by the end of 2007, when the coal-fired plants are to be closed, but should be available by about the same target date as that of the new clean generation called for by the OME RFP [17].

At present, sources classified as renewable energy sources provide only about 1% of Ontario's electricity, 1835 GWh per year, with about 90% of this energy, 1635 GWh/yr, from wood and pulp mill waste and only about 10%, 180 GWh per year, or 0.1% of the total, from wind [27].

As noted in section 4.2, the Ontario Ministry of Energy issued, on April 28, 2004, a request for expressions of interest and qualifications for the provision of 300 MW of renewable energy sources of electricity [16, 17, 18], as a step towards meeting targets of 1350 MW by 2007 and 2700 MW by 2010. Specified as renewable energy sources in this request are wind, solar, water, biomass and landfill gas. The Ministry has received 90 expressions of interest to this request with proposals totalling 4400 MW and has requested that firm proposals be submitted by August 25, 2004 [30].

5.2 Inherent Weaknesses of Alternative Energy Sources for Large-Scale Power Generation

Since this paper deals with options for Ontario's coal-fired plants, we need to understand the role of alternative energy sources for this purpose. This requires a recognition of the characteristics of these sources, in particular, wind and solar, which are often proposed or suggested alternatives to conventional electricity generation. Solar and wind have two inherent weaknesses for large-scale electricity production: low intensity[10] and intermittency[11]. The low intensity requires large areas to collect the energy and intermittency means that the energy is not always available when needed. The intermittency drawback can be overcome to some extent by provision for energy storage when it is feasible, but this provision may increase the area requirements for collection of energy even further. For example, an analysis has shown that the land area required for a solar-thermal electricity plant to replace the Pickering nuclear power plant near Toronto in providing base-load service, i.e., including provision for storage as thermal energy, in a typical December would be over 600 sq.km., about the size of the Toronto metropolitan area, compared to the area of the Pickering plant, 2 sq.km.[31]. The land costs for the solar plant would be astronomical and the use of so much land for a single purpose in a densely populated area would be socially disruptive.

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[9] The lack of economic sites for large-scale hydro development in Ontario is underlined by the results of a study of the feasibility of building a new 600 MW hydro power unit at the Adam Beck site which found that this proposal was uneconomic [28, 29]

[10] Since solar energy generates wind energy by differential heating of the earth's surfaces, the low intensity of wind energy results from the low intensity of solar insolation, about 1 kW/m^2 maximum and about 0.14 kW/m^2 on an average at the earth's surface in Canada [12].

[11] Biomass also has the limitation of low intensity, since its production is governed by solar energy. The intermittency deficiency is overcome by storage of solar energy by photosynthesis in the biomass. However, this process takes considerable time to provide quantities needed for large-scale power production..

While large-scale solar electricity generation has not been seriously proposed for Ontario, wind power already produces about 180 GWh/yr from an installed capacity of 110 MW [27], proposals for additional wind plants have been made and wind plants will probably contribute to the 300 MW of new renewable energy called for by the Ontario Ministry of Energy [30]. The low intensity of wind power results in a requirement for many large wind turbines to generate any significant power. Furthermore, these turbines have to be well-spaced to ensure that wake effects on adjacent turbines do not reduce blade efficiency, and thus power generation, significantly. Based on data from different sources, the power-to-area intensity for wind farms varies from about 2.8 MW/km^2 to about 5.0 MW/km^2 [32, 33, 34]. Therefore, to replace the capacity of the OPG coal plants by wind power plants, assuming an optimistic power intensity of 4 MW/km^2, would require a total area of about 1,900 sq.km., about three times the size of metropolitan Toronto. The cost and difficulty of assembling adequate wind sites over such an area in southern Ontario would be prohibitive, even though some of the required area would also still be usable for agricultural purposes. In addition, the total electricity produced annually by this capacity would be considerably less than that produced by the coal-fired plants because of the low annual capacity factors of the wind plants. From the above data on the current installed capacity and energy production of wind power plants in Ontario, the annual capacity factor of these plants is 18.7%, compared to about 60% to 65% for the coal-fired plants. An ACF of 18.7% is on the low side of the range of ACFs for existing wind farms, 20% to 30% [35]. Assuming an average ACF of 25%, replacing the coal-fired plants by the same capacity of wind-fired plants would result in the generation of only about 40% of the electricity produced in a year by the coal-fired plants. Furthermore, unlike power from the coal-fired plants, power from the wind plants would not be available on demand to meet varying loads, but would depend on the variability of the wind. Since there is no practical means of storing electricity directly on a large scale, building additional wind plants to overcome this intermittency would not be helpful[12].

In effect, wind plants cannot really replace the coal-fired plants, since they cannot meet the requirements of intermediate-load service, that is, being available on demand to meet varying loads over a day or other period. Similarly, wind plants cannot be used for base-load to provide continuous power or for peaking plants to provide peak power on demand. Wind generation is only useful for now as displacement energy, being accepted by the grid, when it is available, in preference to energy from conventional plants whose operating costs at that time are greater than those of the wind energy plants .

It is informative to consider why large-scale hydro plants, generating 23% of Ontario's electricity and about 58% of Canada's in 2003 [27], are not constrained by the limitations of low intensity and intermittency that affect solar and wind energy plants, in spite of being themselves renewable energy plants depending ultimately on solar energy through the hydrologic cycle. For a large-scale hydro plant, nature herself makes up for these deficiencies by collecting precipitation over a large area, the drainage area of the river on which the plant is

[12] Conceptually, wind power plants could be used with indirect storage systems, such as by providing electricity when available for a pumped hydro system or, in the future, for hydrogen production by electrolysis, but the technical and economic feasibility of such applications have not been demonstrated. In any case, they are not available now as options to the OPG coal-fired plants.

located, thus compensating for the low intensity but also smoothing out the intermittency of the precipitation over the drainage area. Nevertheless, nature generally still has to be assisted in compensating for intermittency, by the building of a dam or dams on the river to provide water storage.

A significant practical problem would arise should the fraction of electricity generated by wind in Ontario reach more than a few percent of the total as is the case in Denmark, where wind energy provides about 12% of electricity[13] in a typical year [36]. The management of the stability of the electricity grid with such a fraction of unreliable and randomly varying generation becomes very challenging.. This challenge has been described by a senior Danish utility manager as akin to attempting to manoeuvre a rapidly moving tractor-trailer with no brakes, clutch, accelerator or steering wheel [37]. Meeting this challenge in Denmark is possible mainly because of the strong interconnections between the Danish grid and the Swedish and German grids [37], which can provide reliable nuclear and coal-fired electricity to Denmark, as needed, to compensate for the variability of the winds. While this problem is not likely ever to arise in Ontario, it represents another aspect of the limitations imposed by the intermittency of supply from wind power plants.

Because of the predominance of wind energy amongst alternative energy sources, the rest of this section will deal solely with aspects of wind energy.

5.3 The Economics of Wind Energy

Wind plants, like hydro plants, have very low operating costs because they have no fuelling costs, only labor and maintenance costs. Unit energy costs for the recovery of capital, however, are high because of the large structures, wind turbine-generators and gearing and control components needed as well as the large land requirements. Most large-scale wind turbine-generators today have capacities in the range of about 500 kW to 2 MW, with production beginning on 3 MW units [35, 38]. The 3 MW unit will sit on a 75 metre tower and has turbine blades about 90 metres in diameter [38], so that the tips of the blades are as high as 120 metres above the ground, about the height of a 40 storey building. Smaller units still require tall towers, 50 metres for utility-scale turbines, to ensure exposure to adequate wind speeds, and large-diameter blades, typically 40 to 50 metres [35] . Thus, for a relatively small wind farm of 100 MW capacity, about 34 of the 3 MW units would be required, requiring about 25 sq. km of land. The capital cost, exclusive of land cost, for large-scale wind power plants today is about $1000/kW (US), or about $1350/kW (Can.), for land-based plants [36, 39] and about 1.5 to 2 times as much for off-shore plants, such as have been built in Denmark, the UK, Germany and elsewhere [36]. Therefore, unit energy costs for capital recovery for a land-based plant, assuming a 15% discount rate and a capacity factor of 25%, would be about 9.2 cents per kilowatt-hour, ignoring land costs. Operating and maintenance costs would add one or two cents per kWh. Thus, the real unit energy cost of wind energy would be well above the capped price to domestic and other small consumers in Ontario [26]. The subsidy provided until 2007 for wind power installations in Canada by the Canada Wind Power Production Initiative of 0.8 to 1.2 cents/kWh [40] would reduce, but not make up, this difference.

[13] The remainder is provided by coal-fired plants and by imported electricity from Sweden and Germany.

5.4 Wind Energy and the Environment

Wind power, like hydro power, emits essentially no air pollutants in operation and therefore is held in high regard by environmentalists and the public. Nevertheless, large-scale wind generation does result in certain environmental impacts that need to be recognized. In addition to the large surface areas required, these include:

* bird kills by the moving turbine blades, particularly at night and where wind turbines are located on migratory bird flyways [32, 41, 42],

* low-frequency noise resulting from the turbine blades passing the supporting towers, which may have adverse health effects as well as causing annoyance to those living nearby [32, 43] ,

* interference with defence radar, which has resulted in the refusal for permission to build an offshore wind farm in the UK, and with radio and television reception [32, 44],

* visual impacts of large wind farms which have resulted in opposition to wind farms in some locations, particularly in national parks [32, 45],

* potential impacts of turbine blade failure on nearby residents [32, 39] .

Siting of wind farms at well-chosen offshore sites, such as on the Great Lakes, would alleviate or overcome many of these difficulties, but at the expense of increased capital costs as noted in section 5.3. To avoid health impacts, the risk of injury and noise effects, some jurisdictions have required wind turbines to be located a minimum distance of from 500 to 1000 metres from roads or houses, generally increasing land requirements and thus costs [32, 46].

A thorough assessment of the environmental impacts of large-scale wind power developments and the pros and cons of large-scale wind power in general, in the context of a proposed wind power development in Prince Edward County, Ontario, is provided on a website maintained by a local group in that county [32]. A recent press report has summarized growing opposition in Europe to wind farms because of these environmental issues [47] and a political party has been formed in Scotland to oppose further development of wind power there [48].

These issues do not mean that wind power does not have a role to play in providing electricity in Ontario, but it must be recognized that such issues coupled with wind power's inherent deficiencies will severely limit its contribution to reliable electricity generation in this province. For example, should the target of the Ontario government to achieve 2700 MW of wind power capacity by 2010 be met, the annual electricity generation would be less than that of one of the Bruce-B nuclear units, based on typical annual capacity factors, and, unlike electricity from the Bruce-B, would not be available on a predictable schedule.

6.0 REPLACEMENT OF COAL-FIRED GENERATION BY INCREASED IMPORTATION OF ELECTRICITY TO ONTARIO

The Ontario grid is interconnected with three American states: Minnesota (150 MW capacity), Michigan (2450 MW capacity) and New York (2500 MW capacity, 2 connections) and two Canadian provinces: Manitoba (245 MW capacity) and Quebec (1395 MW capacity, 4 connections) [1, Fig.6b]. All these interconnections can be utilized for exports as well as imports. In 2003, Ontario was a net importer of electricity, with 2240 GWh from Quebec, 645 GWH from Manitoba and 2000 GWh from the US [27]. Early in the 1990s, Ontario was a net exporter of electricity, but the lay-up of the nuclear plants in 1997 and 1998 resulted in Ontario becoming a net importer since then [49]. While the total capacity of the interconnections is about 6600 MW, the effective capability for electricity imports to Ontario is about 4000 MW [3].

Although interconnection of the Ontario grid with US grids resulted in the Ontario power blackout of August 2003 [50, 51], interconnections in general are valuable since they improve the economics and reliability of power generation as well as reducing the need to build new capacity [1, 21]. The interconnections with the US, with utilities with a roughly similar generation mix, enable overall reductions in generating costs by taking advantage of the diversity of loads over the interconnected grids. However, the US interconnections do not provide access to any significant unused capacity that could provide firm power over a prolonged period beginning in three years and thus they cannot serve as replacements for the coal-fired plants.

The interconnections with Manitoba and Quebec could possibly provide Ontario with access to low-cost hydro power on a firm basis, assuming further development of hydro projects in those provinces, such as the Lower Churchill project, which is in Labrador but to which Quebec has access through long-term firm contracts [27].

However, energy to replace the Ontario coal-fired plants from any development in Manitoba would require a significant increase in the capacity of the interconnection from its present 245 MW capacity. Construction of larger-capacity transmission lines would be very costly, would take considerable time and would have to be based on firm commitments for new hydro development in Manitoba as well as the guarantee of long-term energy supply contracts to Ontario. Also, supply by transmission line from Manitoba would not satisfy the condition of the IMO that replacements be located in the same general area as the replaced plant and be similar in characteristics.

The interconnections with Quebec have more capacity, about 1400 MW, than that with Manitoba, and an additional 1250 MW interconnection has been proposed [27]. Nevertheless, as with Manitoba, additional transmission lines would have to be built over the next few years and firm long-term contracts would have to be available to enable the coal-fired plants to be replaced with hydro power from Quebec. Again the IMO condition for replacement power would not be satisfied.

7.0 REPLACEMENT OF COAL-FIRED GENERATION BY NUCLEAR GENERATION

7.1 Recent Additions to In-Service Nuclear Capacity

With three laid-up nuclear units, one at Pickering-A (unit 4) and two at Bruce-A (units 3 & 4), returning to service in 2003 and early 2004, Ontario's nuclear power in-service capacity has been increased by about 2015 MW [27, 52] in the last year. Addition of this nuclear base-load capacity to the Ontario grid has reduced the need for the coal-fired plants to operate as base-load plants, as they have done periodically since the Pickering-A and Bruce-A units were laid up, as mentioned in section 2.1 of this report, and thus will reduce air-pollutant emissions to some degree. Recent information from the IMO website shows that reduced operation of the coal-fired plants is already occurring because of the recently added capacity in Ontario. During the months of June, July and August, 2003, the coal-fired plants produced 9.9 TWh of electricity, while they produced 5.5 TWh during the same months in 2004, a reduction of about 45% [53].

7.2 Committed and Potential Additions to Nuclear Capacity

Additional nuclear generation could be provided by restarting the remaining laid-up reactor units, three at Pickering-A and two at Bruce-A. However, certain issues needed to be dealt with before these restarts could begin.

In the case of the Pickering station, the actual cost of the refurbishment of Pickering unit 4, about $1.25 billion, exceeded the estimated cost by a factor of almost three and the schedule slipped by more than two years from the original projection, so that questions arose about the economics and practicality of restarting the remaining units[14]. The Ontario government appointed a Pickering Review Panel to determine the causes of the cost and schedule overruns of the unit 4 restart [54]. The Review Panel identified the causes of the overruns and made recommendations to avoid them, should the government decide to restart the remaining units. Based on the findings and recommendations of the Review Panel and its own assessment of these, another body appointed by the government, the OPG Review Committee [5], recommended that Ontario proceed with the refurbishment of Pickering unit 1, based on two key findings: procedures to prevent the problems with unit 4 from reoccurring were in place and refurbishment of unit 1 was the least expensive and quickest means for Ontario to build needed new capacity. Based on this recommendation, the Ontario government has recently approved the return to service of Pickering unit 1 [55], which will provide an additional 515 MW of base-load capacity to the Ontario system when the refurbishment, estimated to cost about $900million[15], is completed in about 15 months, i.e., before the end of 2005. The OPG Review Committee also recommended, and the government has agreed, that OPG wait until

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[14] The refurbishment of Bruce units 3 & 4 cost about $720 million and was completed within about six months of the scheduled date [52].

[15] This amount includes sunk costs of about $325 million, covering work already done on unit 1, as part of the original refurbishment project [5]. Reference 5 cites a total cost, including sunk costs, of $825 million and an in-service date of September 1, 2005 for the Pickering-1 restart.

there is clear evidence of success on the unit 1 project before proceeding with any further work on refurbishing Pickering units 2 and 3 [5].

In the case of the Bruce-A station, the cost and schedule of restarting units 1 and 2 is expected be higher than those associated with the restart of units 3 and 4 because of the need to replace the steam generators, which was not the case for units 3 and 4. Bruce Power is evaluating the case for the restart of these two units, but a decision has not yet been made [56].

However, additional nuclear capacity will be provided over the next few years by improvements at the Bruce-B units. Bruce-B capacity will be increased by about 400 MW by the use of new CANFLEX Low Void Reactivity Fuel bundle design, developed by AECL, and the installation of higher-efficiency low-pressure turbines [57]. The new-design fuel bundles have already been loaded into Bruce unit 6 and the new turbines are now being installed in that unit [57, 58].

Therefore, with the restart of Pickering-A unit 1 and the Bruce-B upgrade, additional nuclear capacity totalling about 915 MW will be available to the Ontario grid over the next few years. There is also the potential of restarting Pickering-A units 2 and 3, adding 1030 MW, and Bruce-A units 1 and 2, adding 1500 MW, for a total of 2530 MW capacity that may be added to the Ontario system. Bruce Power is also assessing the eventual refurbishment of the four Bruce-B units to extend their lifetime well into the future [56].

7.3 Limitations of Nuclear Generation in Replacing Coal-Fired Generation

As discussed above, about 2930 MW (1030 MW at Pickering-A, 1500 MW at Bruce-A and 400 MW at Bruce-B) of nuclear capacity will have been added to the Ontario grid from 2003 to 2007, which will reduce the need for the coal-fired plants to function as base-load plants and will thus reduce emissions of air pollutants, as is already happening as noted above [53]. This added capacity will also reduce the need to import electricity into Ontario from the US, thus indirectly reducing the concentrations of air pollutants in Ontario from emissions from coal-fired plants in the US.

Nevertheless, this added nuclear capacity would not completely displace the equivalent coal-fired plant capacity in meeting intermediate loads, i.e. in load-following over a day or a week. The nucleonic characteristics of the natural uranium CANDU core and the design of the power control systems place constraints on changes in power level [59]. Current CANDU reactors do not normally operate at steady power levels less than about 60% of full power, because reducing the power from full power to a level lower than about 60% results in the build up of fission product xenon, a strong neutron absorber, in the fuel to the extent that the control system is unable to prevent the reactor from "poisoning out", i.e., shutting down [51, 60]. Also, should a CANDU unit operating at full power be shutdown to zero power, the restart must begin within about half an hour; otherwise it cannot be brought back up to full power

until after the xenon in the fuel decays sufficiently, about 36 hours later[16]. It will then take about five hours to bring the reactor to full power from zero power. These constraints hinder nuclear plants from readily meeting intermediate loads on a regular basis.

Even if there were no physical constraints on load-following with the Ontario reactors, economic penalties will be incurred by this mode of operation. With the high capital costs of nuclear power plants compared to those of coal-fired plants, the nuclear plants must be operated at high annual capacity factors, i.e., as base-load plants, to keep unit energy costs reasonably low [12].

7.4 Future Need for Nuclear Generation in Ontario

The demand for electricity in Ontario is expected to grow considerably in the future. The Independent Electricity Market Operator forecasts that demand will grow by as much as 17% from now to 2014 [3] while the National Energy Board forecasts an increase of 21% by that date and by about 40% by 2025 [27]. Therefore, there is a consequent need for additional base-load capacity in Ontario to ensure that this increasing demand can be met and to ensure an adequate reserve margin. Base-load capacity requirements in Ontario are now met mainly by the nuclear plants and by the large-scale run-of river hydro plants [3]. There is little possibility of increasing large-scale hydro generation in the future in Ontario, as noted in section 5.1 and new coal-fired plants would not be acceptable. The cost of natural gas is too high and its long-term supply is too questionable to rely on CCGT plants for base-load power. The unreliability of wind power and other alternative sources preclude their use for base-load purposes.

Therefore, the only realistic option for future base-load power is to increase nuclear generation, as recognized by many knowledgeable organizations and individuals [3, 5, 27, 54, 56, 61]. The restart[17] of the remaining laid-up nuclear units at Pickering-A and at Bruce-A would just get Ontario back to where it was with nuclear capacity in the first half of the 1990s and new reactor capacity will be needed. Bruce Power is now assessing the building of new nuclear generation [56], using AECL's Advanced CANDU Reactor 700 MW (ACR-700) design, featuring considerably reduced capital costs, low operating costs and, eventually, a 36-month construction schedule [63]. The ACR should be market-ready by mid-2007 and the first two units could come on line by about 2012. A recently released study by the Canadian Energy Research Institute, confirms that nuclear power, either the ACR-700 or a CANDU-6 design, would provide the most economic base-load power for Ontario under public financing conditions, compared to a combined cycle gas turbine plant and a coal plant equipped with flue-gas desulfurizers [64].

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[16] In an emergency, Ontario nuclear plants can disconnect from the grid and continue to operate at 60% load by transferring energy to the steam generators as in normal operation, with the steam being discharged to atmosphere (Pickering-A, Pickering-B and Bruce-A) or recirculated to the condensers (Bruce-B and Darlington). For the Pickering plants and Bruce-A, this mode of operation could continue as long as de-mineralized water was available and for Bruce-B and Darlington, it could continue indefinitely. A plant can then be brought back on line as needed. The latter procedure was followed at three Bruce-B units and one Darlington unit following the power blackout of August, 2003, which enabled these units to begin producing power for the grid within a few hours after the blackout started [50, 51].

[17] The Ontario government has just announced that it is to begin negotiations to restart units 1 and 2 at Bruce [62].

As nuclear generation grows as a fraction of the total generation in Ontario, it would eventually be advantageous for nuclear units to load-follow more readily than they can now, so it would be useful for the ACR to have enhanced load-following capability. In this regard, with the projected unit capital cost of the ACR, about $1350/kW, much reduced from that of current CANDU-6 reactors, about $2200/kW, the economic penalty associated with intermediate-load operation would be less with the ACR design than with the current CANDU-6 design.

Nevertheless, nuclear generation for a number of years in the early1990s produced over 60 % of Ontario's electricity [65], so that a significant increase in nuclear's present contribution of about 40% is clearly feasible, in spite of any physical and economic limitations to the operation of nuclear power plants as intermediate-load plants.

8.0 CONCLUSIONS

Based on the foregoing assessments, certain conclusions can be reached on the various options for the coal-fired plants in Ontario. In reaching these conclusions, a commitment of the Ontario government about the closing of the coal-fired plants must be kept in mind: "We remain committed to replacing coal-fired electricity generation in the province. In so doing, we will never put Ontario consumers in jeopardy and will be totally satisfied that adequate alternatives are in place before we replace coal." [66] .

In reaching conclusions on these options, it should be kept in mind, as discussed in section 2, that conservation alone is not really a separate option for reduction of air pollution from coal-fired plants in Ontario, although it will assist any of the options by reducing demand to some extent.

8.1 Actual and Committed Additions to Ontario Intermediate Load Capacity, 2003 to 2009

From the foregoing assessment, the actual and committed additions to the Ontario grid are summarized in Table 5, which also shows the suitability of the added capacity for intermediate-load operation, as would be needed to replace the coal-fired generation.

As shown in Table 5, actual and committed additions to the Ontario grid that are fully capable of meeting intermediate loads total 3355 MW, but this capacity will only be fully available by June 1, 2009, at the earliest. In addition, additional nuclear capacity of 2930 MW will be fully available by about 2007, but there are limitations to the ability of this capacity to meet intermediate loads. The ultimate total capacity in these two categories is about 6800 MW, less than the 7578 MW capacity of the coal-fired plants, and not all of this added capacity is capable of meeting intermediate loads on a regular basis. Therefore, it is apparent that the Ontario coal-fired plants cannot be completely replaced by the actual and committed additions to the grid, and these replacements will not be completely available until the middle of 2009.

Therefore, the Ontario coal-fired plants cannot all be shut down by 2007 if the commitment of the Ontario government that adequate alternatives will be in place before coal plants are replaced is to be fulfilled.

TABLE 5

ACTUAL AND COMMITTED ADDITIONS TO ONTARIO CAPACITY
2003 TO 2009

	MW, INTERMEDIATE LOAD CAPABLE?			
PROJECT	YES	PARTLY	NO	IN-SERVICE[18]
Brighton Beach	580			2004
Portlands	550			?
Northlands	25			?
M of E RFP	2000[19]			June 1, 2009
Beck Tunnel	200			2008
Renewables			300	Dec. 31, 2007
Pickering-4		515		Sept.25, 2003
Bruce-4		750		Oct. 7, 2003
Bruce-3		750		Jan.9, 2004
Pickering-1		515		2005
Bruce-B Upgrade		400		2007
Total	3355	2930	300	

8. 2 Improvement of Emission Controls at Coal-Fired Power Plants

Table 3, in section 3, shows that the installation of selective catalytic reducers (SCR)and flue gas de-sulfurizers (FGD) at the Nanticoke and Lambton coal-fired plants, representing almost 6000 MW of capacity, about 80% of the total coal-fired capacity in Ontario, would result in significant reductions in emissions of the major air pollutants NO_x and SO_2, with emissions of NO_x being reduced to 25% and of SO_2 to 20% of the present amounts. Installation of this equipment at these plants would require an investment in the estimated range of $3 billion to $4.3 billion. However, maintaining these plants in operation with these emission controls added would avoid the premature write-off of valuable assets, at an annual charge of about $576 million.

[18] Date of final addition of capacity

[19] Assumes that 500 MW of the RFP request will be met by demand-reduction measures, which, as a minimum, will be balanced by demand growth.

Before deciding to close the Nanticoke or Lambton plants in 2007, it would be prudent to undertake a cost-benefit analysis of the addition of SCRs and FGDs at least at one of these plants, taking into account health benefits resulting from the significantly reduced emissions, as suggested in the Manley Report [5]. Keeping the Nanticoke plant open by adding SCRs and FGDs would have the benefit of reducing emissions significantly while retaining over 3900 MW of intermediate-load capacity for the Ontario system, which, with the committed and planned gas-fired capacity, would provide about 7300 MW of intermediate-load capacity, almost the same as now provided by all the coal-fired plants. This step could be completed by about 2007 if the commitment were made soon and would avoid any economic penalties and operational difficulties resulting from having to operate nuclear plants as load-followers.

8.3 Replacement of Coal-Fired Generation by Natural Gas-Fired Generation

It is evident from Table 5 that committed and planned natural gas-fuelled generation, about 3155 MW, will only be able to replace about 42% of the total 7578 MW of coal-fired power. The cost of replacing most of the rest of the coal-fired power with natural gas-fired power, for example by building a CCGT plant to replace Nanticoke, would be very high and would face issues of gas supply and costs over the lifetime of the gas-fired plants, as discussed in section 4.

It is concluded that increasing the reliance on natural gas-fired generation in Ontario much beyond present commitments and plans would raise concerns about the reliability of gas supplies and would probably result in increasingly high costs of electricity generation.

Shutdown of the coal-fired plants at Thunder Bay and Atikokan would require replacement capacity of about 500 MW to be located in the same general areas to meet the IMO requirement for voltage support and for transmission security. Since gas transmission costs to these areas would be less than to central Ontario, gas-fired generation would be appropriate for this purpose, so that some of the proposed or future gas-fired plants should be located there.

As a special case, the conversion of the Lakeview plant to the burning of natural gas to generate steam for its turbines, rather than closing it in 2005, might be considered because of its important role in maintaining transmission system reliability and sustaining local voltages by its proximity to Toronto.

8.4 Replacement of Coal-Fired Generation by Renewable (Alternative) Energy Sources

As made clear in section 5, wind and solar sources suffer from two inherent deficiencies for large-scale electricity production, low intensity and intermittency. The low intensity results in a requirement for very large surface areas for a given capacity. Replacement of the Ontario coal-fired capacity by wind power would require suitable sites over an area of about 1900 km^2, but

this capacity would produce only about 40% of that produced by the coal plants because of wind intermittency. Because of its intermittency, wind generation cannot really replace the coal plants in meeting intermediate loads, since it is not available on demand and cannot be cycled to meet changing load demands. Also, experience in Denmark shows that stability problems arise when wind power becomes more than a relatively small contributor to an electricity grid.

Because of the need for many large wind turbines for any significant generation capacity, the capital costs of wind energy are high, and the wind's intermittency means that capacity factors of wind farms are very low, only 20% to 30%. Thus, the unit energy costs for recovery of capital are very high, typically about 9 or 10 cents per kWh, well above the capped rate for small consumers in Ontario.

The operation of wind plants, while avoiding emissions of air pollutants, is not free from all environmental impacts, as described in section 5.

It is concluded that wind energy is not a realistic option to replace the coal-fired plants and will continue to play only a very minor role in electricity generation in Ontario.

8.5 Replacement of Coal-Fired Generation by Increased Importation of Electricity to Ontario

The effective capability for electricity imports into Ontario from the US, Manitoba and Quebec is now about 4000 MW, as stated in section 6. The US interconnections do not provide access to any significant unused capacity that could provide firm power over a prolonged period and thus they cannot serve as replacements for the coal-fired plants.

The interconnections with Manitoba and Quebec could possibly provide Ontario with access to low-cost hydro power on a firm basis. However, since the capacity of these interconnections is low, construction of larger-capacity transmission lines would be needed, would be very costly, would take considerable time and would have to be based on guarantees of long-term firm energy supply contracts.

While strengthened interconnections with the US and Quebec and Manitoba would be generally beneficial, increased importation of electricity into Ontario is not a viable solution on its own for replacing coal-fired generation by the target dates.

8.6 Replacement of Coal-Fired Generation by Nuclear Generation

As discussed in section 7, technical limitations constrain the operation of CANDU units as intermediate load plants and there also is an economic penalty for such operation. The economic penalty of operating at reduced load will be less for the ACR-700 design than for the CANDU-6 design.

Almost 3000 MW of nuclear capacity will have been added to the Ontario grid in the period from 2003 to 2007, which will reduce, or even eliminate, the need for the coal-fired plants to function as base-load plants, as is already occurring, and will thus reduce emissions of air pollutants. This added capacity will also reduce the need to import electricity into Ontario from the US, thus indirectly reducing the concentrations of air pollutants in Ontario from emissions from coal-fired plants in the US.

Strong growth of electricity demand in Ontario is expected in the future. New base-load generation capacity will be needed soon, in addition to that which may be provided by the restart of the four remaining laid-up reactor units at Pickering and Bruce. The only realistic option for new base-load capacity in Ontario is nuclear, using either the new Advanced CANDU Reactor or the well-established CANDU-6 design

As the percentage of nuclear generation in Ontario grows to and beyond the level of about 60% attained in the early 1990s, the ability of CANDU reactors to operate to some degree as load followers will become more important, so enhanced ability in load following should be a design criterion for new nuclear generation in Ontario.

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Remarks Of Senator Alexander - Windmill Legislation Introduction

May 13th, 2005 - I am here today to introduce - along with the senior senator from Virginia, Senator John Warner - the Environmentally Responsible Wind Power Act of 2005.

Our legislation provides for local authorities to be notified and have a role in the approval of the siting of tens of thousands of massive wind turbines that will be built in America under current policies. It also ensures that the federal government does not subsidize the building of these windmills - which are usually taller than a football field is long - within 20 miles of a military base or a highly scenic location, such as a national park or offshore.

Senator Warner and I introduce our legislation today because next week the Senate Energy Committee is scheduled to begin markup of one of the most important pieces of legislation of this session, an energy bill. The Energy Committee's work -combined with the work of the Environment and Public Works Committee and the Finance Committee - should this year produce a clean energy bill that will, over time, lower prices of natural gas and oil and reduce our dependence on overseas oil.

This will be legislation for American blue collar workers, for farmers and for homeowners. It is urgently needed. Natural gas prices are the highest in the industrialized world. Gasoline prices are at record levels. We cannot keep our jobs and our standard of living if we do not put in place policies that will provide our country with new steps toward conservation and an adequate supply of low cost, reliable, clean, American-produced energy. Senator Warner and I both intend to be in the middle of this discussion. He is a senior member of the Environment and Public Works Committee. I am chairman of the Energy Subcommittee.

I am grateful for and am greatly encouraged by the leadership of the Energy Committee Chairman, Senator Domenici, and the ranking Democrat, Senator Bingaman, and the committee staffs, who have worked especially hard to create a framework for a more aggressive, bipartisan piece of legislation.

One part of our energy debate will be about wind power, which is the subject of our legislation today. This is because several of our colleagues have proposed something called a Renewable Portfolio Standard, or RPS, which would require power companies to produce 10 percent of all their electricity from renewable sources by 2025. These renewable sources are wind, hydro, solar, geothermal and biomass. Today these renewable sources produce about 9 percent of U.S. electricity needs. This RPS is not to be confused with a Renewable Fuel Standard - which is a requirement that gasoline contain a certain percentage of ethanol. A Renewable Fuel Standard is entirely different from a Renewable Portfolio Standard and may well be part of the final legislation.

It is important for our colleagues to know that a Renewable Portfolio Standard or RPS is all about wind. There are very few opportunities to build new dams and expand hydro power, which produces 7 of the 9 percent of renewable power we use today. Of the remaining 2 percent of renewal power sources, current subsidies aren't enough to increase solar power by very much. More research and development is needed to make biomass more efficient. And there is limited availability of geothermal power, that is, drawing power from water that is heated underground.

Which leaves wind power. Experts agree that the bottom line is that a requirement that electric companies produce 10 percent of their electricity from renewable energy, if it could be achieved at all, would mean that about 70 percent of the increase would come from wind. In other words, we would go from producing about 1 percent of our electricity from wind to 7 or 8 percent.

Testimony before our Energy Committee and most other sources suggest that to produce this much wind energy in the United States could require building more than 100,000 of new, massive wind turbines. We have less than 7,000 such windmills in the U.S. today, with the largest number in Texas and California.

Testimony also indicated that, even without the RPS, if Congress continues its sustained generous subsidy for wind production for the next 10 years, it will guarantee that the U.S. has about 100,000 of these windmills by 2025. According to the Treasury Department, this wind subsidy, if renewed each year for the next five years, would reimburse wind investors for 25 percent of the cost of wind production and cost taxpayers $3.7 billion over those 5 years. General Electric Wind, one of the largest manufacturers of wind turbines, has experienced

a 500 percent growth in its wind business this year due to the renewal of the wind production tax credit last year.

I want to make sure that my colleagues know that there are serious questions about how much relying on wind power will raise the cost of electricity, questions about whether there are better ways to spend $3.7 billion in support of clean energy, questions about whether wind even produces the amount of energy that is claimed. My studies suggest that at a time when American needs large amounts of low-cost reliable power, wind produces puny amounts of high-cost unreliable power. We need lower prices; wind power raises prices. We will have an opportunity in our debates and further hearings to examine these questions.

But the legislation we offer today is about a different question: the siting of 100,000 of these massive machines.

The idea of windmills conjures up pleasant images - of Holland and tulips, of rural America with windmill blades slowly turning, pumping water at the farm well. My grandparents had such a windmill at their well pump. That was back before rural electrification.

But the windmills we are talking about today are not your grandmother's windmills.

Each one is typically 100 yards tall, two stories taller than the Stature of Liberty, taller than a football field is long.

These windmills are wider than a 747 jumbo jet.

Their rotor blades turn at 100 miles per hour.

These towers and their flashing red lights can be seen from more than 25 miles away.

Their noise can be heard from up to a half mile away. It is a thumping and swishing sound. It has been described by residents that are unhappy with the noise as sounding like a brick wrapped in a towel tumbling in a clothes drier on a perpetual basis.

These windmills produce very little power since they only operate when the wind blows enough or doesn't blow too much, so they are usually placed in large wind farms covering huge amounts of land.

As an example, if the Congress ordered electric companies to build 10 percent of their power from renewable energy - which as we have said, has to be mostly wind - and if we renew the current subsidy each year, by the year 2025, my state of Tennessee would have at least 1,700 windmills, which would cover land almost equal to two times the size of the city of Knoxville.

If Virginia were to produce 10 percent of its power from wind and the subsidies continue, it would probably need more than 1,700 windmills. These windmills would take up enough land to equal the land mass of three cities the size of Richmond, Virginia.

In North Carolina, to supply 10 percent of electricity from wind if the subsidies continue, it would take up the landmass of the Research Triangle – the Raleigh, Durham, Chapel Hill area.

According to testimony before our committee, in Tennessee and Virginia, these windmills would work best and perhaps only work at all along ridge tops.

So, if present policies are continued, we could expect to see in hundreds of football field sized towers with flashing red lights atop the blue ridges of Virginia, above the Shenandoah Valley, along the foothills of the Great Smoky Mountains, on top of Signal Mountain, and on top of Lookout Mountain and Roan Mountain in Tennessee and down the Tennessee River Gorge, which the city of Chattanooga has just spent 25 years protecting and now calls itself the scenic city.

I hope that we decide, Mr. President, that there are better ways to provide clean energy than to spend $3.7 billion of taxpayer dollars over the next 5 years on windmills. I hope we decide that we need a real national energy policy - instead of a national windmill policy.

I hope we decide that there are better and cheaper ways to discuss carbon.

At least there are some important questions to answer.

What will this do to our tourism industry? Will 10 million visitors a year who come to enjoy the Great Smokies really want to come see ridge tops decorated with flashing red lights and 100-yard tall windmills?

What happens to electric rates when the federal subsidy disappears?

Who will take down these massive structures if we decide we don't like them or if they don't work?

Who is making the money on all this?

Why are some of European countries who pioneered wind farms now slowing down or even stopping their construction in some places?

Clearly there are more sensible ways to provide clean energy than spending $3.7 billion of taxpayers' money to destroy the American landscape.

$3.7 billion would provide us enough money to give 185,000 Americans a $2,000 subsidy to buy a hybrid or clean diesel vehicle - which would about double the number of hybrid cars expected to be sold in the U.S. during 2005. Hybrid cards burn about 60 percent of the amount of gasoline than conventional cars burn.

$3.7 billion would provide enough money for loan guarantees to help launch a dozen new clean coal gasification plants and help transform the marketplace with a new technology for clean, American produced energy that would lower natural gas prices and reduce our dependence on foreign oil.

For 3.7 billion we could provide loan guarantees for at least a half dozen new technology nuclear power plants and have a billion dollars left over for research and development on the recapture of carbon that might be produced by coal plants or to encourage conservation practices.

Just by way of comparison, a nuclear power plant such as TVA's Sequoyah nuclear plant would produce about the same amount of energy as the windmills which a RPS and tax subsidy would build in Tennessee - and the electricity would be available even when the wind wasn't blowing.

While we are debating the wisdom of wind policies, these massive turbines are being built across America, 6,700 of them so far, 29 of them in Tennessee. The Tennessee Valley Authority recently announced it had signed a 20-year contract with a group of investors from Chicago to build 18 huge windmills atop a 3,300 foot ridge on Buffalo Mountain in East Tennessee.

So the purpose of our legislation is to give citizens the opportunity to have some say in where these massive structures are located in their communities and to make sure that the Congress does not subsidize the destruction of the American landscape near our national parks or other highly scenic areas or build such tall structures dangerously close to our military bases.

First, the bill ensures that local authorities are notified and have a role in the approval of new windmills to be built in their areas of jurisdiction. This means that at the same time a proposed windmill is filed with the Federal Energy Regulatory Commission, FERC would notify the local authority with zoning jurisdiction.

Within 120 days, under our bill, local authorities may support or oppose the project. If they support it, the windmill may qualify for FERC market-based rates (allowed to charge wholesale prices) and may be exempt from a series of regulations that restrict the operations of public utilities. If local authorities oppose the windmill, it may still go forward, but subject to regulations (called PUHCA) and unable to charge wholesale rates or issue a qualified rate schedule. If no action is taken by the local authority, the FERC process would proceed as though the authority were in support.

I believe it is crucial that local authorities have a chance to consider the impact of such massive new structures before dozens or hundreds of them begin to be built in their communities. In many other instances involving the location of facilities generating power, state and local governments have developed laws giving citizens an

opportunity to comment or even stop the location of facilities they don't want. Our legislation gives communities that do not now have such laws the chance to do that. Then this legislation sunsets in 7 years.

Second, our legislation provides protection to highly scenic areas and to military bases. It does so my eliminating tax subsidies for any windmill within 20 miles of a World Heritage Area (which includes many national parks), a military base or offshore.

Under the bill, placement of a windmill within 20 miles of such a site shall also require the completion of an environmental impact statement. Further any windmill that is to be constructed within 20 miles of a neighboring state's border may be vetoed by that neighboring state. In other words, if the neighboring state can see it, and don't want it, they can veto it.

I believe that during our debates we will find there are better ways to produce a low-cost, reliable supply of American energy than by spending $3.7 billion over the next 5 years requiring power companies to produce energy from giant windmills that raise electric rates, only work when the wind blows, and destroy the American landscape.

The legislation that Senator Johnson and I have introduced, the Natural Gas Price Reduction Act of 2005, includes support for aggressive conservation, new clean coal gas plants, new supplies of domestic natural gas, and, for the time being, easier import of liquefied natural gas.

I believe there is an important place in our energy bill for renewable fuels, such as ethanol. And I believe there is an important place for renewal energy sources. For example, the legislation Senator Johnson and I introduced a few weeks ago would increase from 10 to 30 percent the tax credit for commercial investments in solar technology that generates electricity, heats or cools a structure, uses fiber optics and illuminates a building, or provides solar process heat. It provides a similar 30 percent tax credit for a solar system that heats a home. But it is important to keep in mind that, aside from wind, renewable energy can only provide about 3 percent of America's total energy needs over the next 20 years.

In the United States of America, Mr. President, the wholesale destruction of the American landscape is not an incidental concern. The Great American Outdoors is an essential part of the American character. Italy has its art. Egypt has its pyramids. England has its history. And we have the Great American Outdoors.

While we debate the merits of so much subsidy and reliance on wind power, we should at the same time protect our national parks, our shorelines and other highly scenic areas, and we should give American citizens the opportunity protect their communities and landscapes before it is too late.

Volume 1, Issue 1
August 2005
A newsletter published by The Blue Highlands Citizens Coalition
www.bhcc.ca

THE WIND POWER SENTINEL

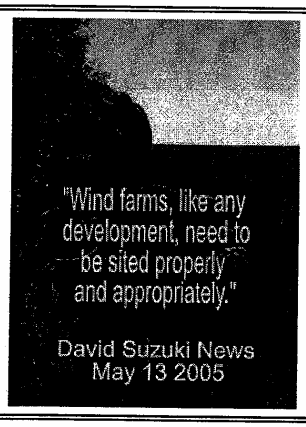
Protecting the Niagara Escarpment Landscape from Industrial Development.

Wind Energy is a Renewable Resource

Our Niagara Escarpment Landscape Is Not

Town of The Blue Mountains Hires Jones Consulting Group

Even though there has been no formal application to TBM and no industrial Wind Energy System bylaws put in place in TBM, the Ministry of Energy has awarded a Renewable Energy Contract to Brascan's Superior Wind Energy subsidiary (aka Brascan Power Wind). Local planning and development issues were not taken into account. The project is proposed for an area of TBM on top of the Escarpment surrounded on three sides by Niagara Escarpment Commission protected lands. Phase 1 of the proposed project is for thirty 400-foot tall turbines in this area. This project cannot proceed without local council approval. The TBM has recently hired the Jones Consulting Group, leaders in wind power planning policy development, to advise them in this matter. The Council will be holding a public meeting on the subject. Any public meeting should be posted on the TBM website at www.thebluemountains.ca once a date is set.



Wind Turbine Noise Conference

This year the First Annual International Conference on Wind Turbine Noise will be held in Berlin, Germany. "Development of onshore wind power brings wind turbines closer to habitation, leading to the possibility of noise problems, such that a frequent objection raised in planning procedures is that of noise and vibration" Their website is www.windturbinenoise2005.org

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Grey Highlands Council Completes Draft Bylaw

Public Meeting to Follow

In June of 2004, Grey Highlands Council passed an "Interim Control Bylaw" which allows Council until June 2006 to develop a planning framework for wind energy systems (WES). No industrial WES applications can be submitted until this framework is complete. They are currently working with the Jones Consulting Group and have just completed their DRAFT bylaws. To date, they have had two public meetings to obtain local input. A third public meeting will be held – no date has been set. Council is looking for your input so it is important to attend. Watch your local paper for a notice or subscribe to the BHCC mailing list. Updates should be posted on the MGH website at www.greyhighlands.ca.

WE ARE NOT ALONE

The inappropriate siting of industrial wind turbines has generated the formation of many community groups worldwide. An extensive list is available at the Protect the Flint Hills website at www.protectthefllinthills.org
Click on
"Who's Concerned"

The Blue Highlands Citizens Coalition – Since 2003 we have been working towards 1) Protection of the Niagara Escarpment and vicinity. 2) Support for responsible and appropriate wind energy development. 3) Responsible, informed decision making regarding the issue of wind power development within affected communities. For more information or to join our group please visit www.bhcc.ca or call 705-446-1798.

NISHNAWBE ASKI DEVELOPMENT FUND
SUMMARY OF
FIRST NATIONS' ENERGY ISSUES
ONTARIO POWER AUTHORITY SUBMISSION

Background

As most First Nations and those who work with the Far North communities, northern Ontario brings both challenges and opportunities for all of Ontarians. However, given the relatively remote nature and geographically dispersed, small population base, there are multiple and unique barriers that hinder First Nation project proponents from acting upon these opportunities on behalf of their community members.

The following is a very brief summary of challenges and suggested process-related improvements and/or inclusive mechanisms as it relates to First Nations energy initiatives in Ontario's Far North.

The underlining set of facts for this submission, as it relates to OPA current assignment is:

1. OPA is a creature of

    a. its legislation under specific sections of the Electricity Act (as amended by Bill 100) regarding coordination of long term electricity planning, and
    b. also responds to direction from the Minister.

2. The major new initiative (in addition to the current call for advice on supply mix) for 2006 is the Integrated Power System Plan (IPSP) which OPA will prepare within the year of 2006 that will be subject to some form of public review process (perhaps before the Ontario Energy Board).

3. The Minister/Ministry of Energy is the body that sets provincial energy policy and proposes new regulations or amendments to existing regulations (such as the RRPP) under the Acts (Electricity and Ontario Energy Board Acts).

In terms of the larger picture, reoccurring First Nations' messages heard from an energy-project level to the Province have been:

- More inclusive engagement in energy planning that affects remote First Nation communities
- More equal level energy 'playing field' between remote First Nations and rest of Province (rates, subsidies and regulation)
- More direct participation in energy infrastructure projects affecting First Nations (local, provincial, and inter-provincial initiatives)

Prepared by Michael Fox, Resource Sectoral Specialist

- The potential Manitoba-Ontario Interconnect should be evaluated not simply as a means to deliver electricity to Ontario, but also as a catalyst or anchor investment that will be the locus of a much broader set of First Nations' economic development activities in the Far North. First Nations should be part of future studies as a way to obtain crucial information and be a position to review any potential transmission options as part of the review team.
- The potential Interconnect investment could provide a First Nation-designed and -controlled infrastructure corridor which would be the locus of:

    a) an all-season road infrastructure;
    b) the regional trigger for other economic development activities;
    c) a secondary source of a local and regional transmission lines that would service remote communities and future resource-based projects led by First Nations;
    d) the destination of electricity generated from remote sources of renewable and possibly non-renewable energy sources.

Key Messages for Ontario Power Authority Submission
Advice to Minister of Energy

First Nations Desired Outcome	Key Challenge	Process Improvement Required
1. Remote First Nation communities be included in provincial energy planning processes (ie: power system planning and supply mix planning)	1) Historically, a demonstrated lack of inclusion of the remote First Nations into provincial regulatory agencies' planning processes 2) An assumed lack of understanding of the energy regulatory environment of the remote northern areas by provincial agencies	- Remote First Nations be formally recognized as a key stakeholder in OPA's and MOE's energy planning processes [For example: the Integrated Power System Plan 2006] - Remote First Nations be represented on Advisory Boards of regulatory agencies (i.e., OPA, IESO, HORC, etc.) [Alternatively establish a Special Advisory Group with those agencies at the OPA-FN focus and priorities] - Remote First Nations be represented in energy related advisory groups (ie: Minister of Energy's Advisory Committee)
2. Sustainable electricity servicing for remote communities at similar rates as other Ontario residents	1) The 12 Independent First Nations Power authorities (diesel dependent communities) are increasingly unsustainable because they are "exempt" by regulation from receiving Rural	- Provide a clear understanding of Ministry of Energy and Ontario Energy Board's policy and regulations to remote First Nations related to First Nation servicing - A clear process be developed and communicated to remote First Nations on a defined process/steps for First Nations to

	Remote Rate Subsidy 2) The lack of a clear process for independently serviced diesel-dependent First Nations to receive services of Hydro One Remotes Communities Inc. HORC, as a provincial utility, receives annual RRRP subsidies to offset the high cost of servicing the 14 First Nations that they have an obligation to serve.	receive electricity servicing by Hydro One Remote Communities where there is an interest. - Hydro One Remote Communities be directed to include the servicing of interested First Nations in their business and operational plan, as a way to close the current rate disparities among remote First Nations.
3. Renewable energy generation to augment/displace diesel consumption being utilize by remote First Nations be supported by Ontario	1) Ministry of Energy's demonstrated practice of restricting RFPs for new power incentives to only grid connected projects 2) Ministry of Natural Resources creation of provincial parks and protected areas around many potential waterpower sites, and MNR's current position of no commercial developments within these said areas.	- Remote north energy options to displacing diesel consumption be included in the future supply mix plans for Ontario -Off-grid renewable energy generation opportunities be included in provincial incentive programs to enhance the financial viability of potential off-grid energy projects - Ontario address the barriers to remote north waterpower development imposed by MNR's policies and practices
4. Provincial support for grid connection for interested remote First Nations be considered as an option to diesel power	1) The high costs and complexity of operating transmission and distribution companies, regulatory limitations to RRRP, pooled transmission rates and financial challenges (ie: inability to secure adequate insurance, cashflow issues, etc) have raised questions on the long term viability of independently owned utilities	- Hydro One Networks should be directed to assess in their business plan the possibility of grid connection and energy delivery of interested remote First Nations with generation projects.

5. To have a better understanding of provincial energy regulations and the relationships between the ministries (MOE & OEB) and provincial service providers like Hydro One and Hydro One Remote Communities	1) Energy regulations affecting remote First Nations fall under both the Ministry of Energy and the Ontario Energy Board. The regulations are complex and unclear as to their impact and limitations on remote First Nations 2) Since former Ontario Hydro was restructured, it is unclear as to what exactly the First Nations relationship between the provincial utilities and the Province	- The Ministry of Energy and the Ontario Energy Board offer a series of regional workshops for First Nations to explain the existing regulations, particularly those affecting remote north servicing and the rules around Independent First Nations Power Authorities - Provincial agencies explain the impacts of the provincial regulations on the Independent First Nations Power Authorities - Transparency of roles and responsibilities of different agencies and the provincial utilities
6. Opportunities for direct participation in provincial electricity infrastructure reviews affecting remote First Nations, like the potential Manitoba-Ontario Interconnect	Provincial interfacing with the individual remote First Nations with small population base and limited understanding of the emerging energy industry, would create substantive challenges.	Provincial recognition of the Chiefs Steering Committee, which has a mandate and confirmation of the need for this primary contact group to continue functioning. Commitment to support the continuation of the Chiefs Steering Committee, recognizing the benefits of access to industry expertise and strong First Nations communications as it relates to both First Nations' long term electricity needs and Ontario's future supply mix.
7. Expanded range of economic development options such as other resource-based projects that would be rendered viable because of available affordable electricity delivered from secondary and tertiary power transmission lines or all season road network coincident with a Manitoba-Ontario Interconnect corridor.	1) Few natural resource developments are economically viable without access to affordable electricity.	Evaluate the Manitoba-Ontario Interconnect options not just in terms of cost per kilowatt, but as a regional economic development investment and as a First Nations' community-based opportunity.

8. Economically viable remote electricity generated from renewable and non-renewable energy sources that feed into the potential Interconnect corridor.	1) There are renewable and non-renewable energy sources in the Far North but these will not be economical without a regional transmission corridor.	Involve First Nations in renewable and non-renewable energy inventory to assess the potential for locally produced electricity that becomes the “local economic engine” for the benefit of First Nations and Ontarians.

With regards to the supply technologies: Any assessment of Nuclear (refurbished or new) must consider the full costs including regulatory framework, decommissioning, and long-term storage of fuel.

I question the long-term sustainability of the Nuclear Liability Act which, like so many things, artificially lowers costs for Nuclear power and impedes fair comparison.

Thanks.

Scott Norris

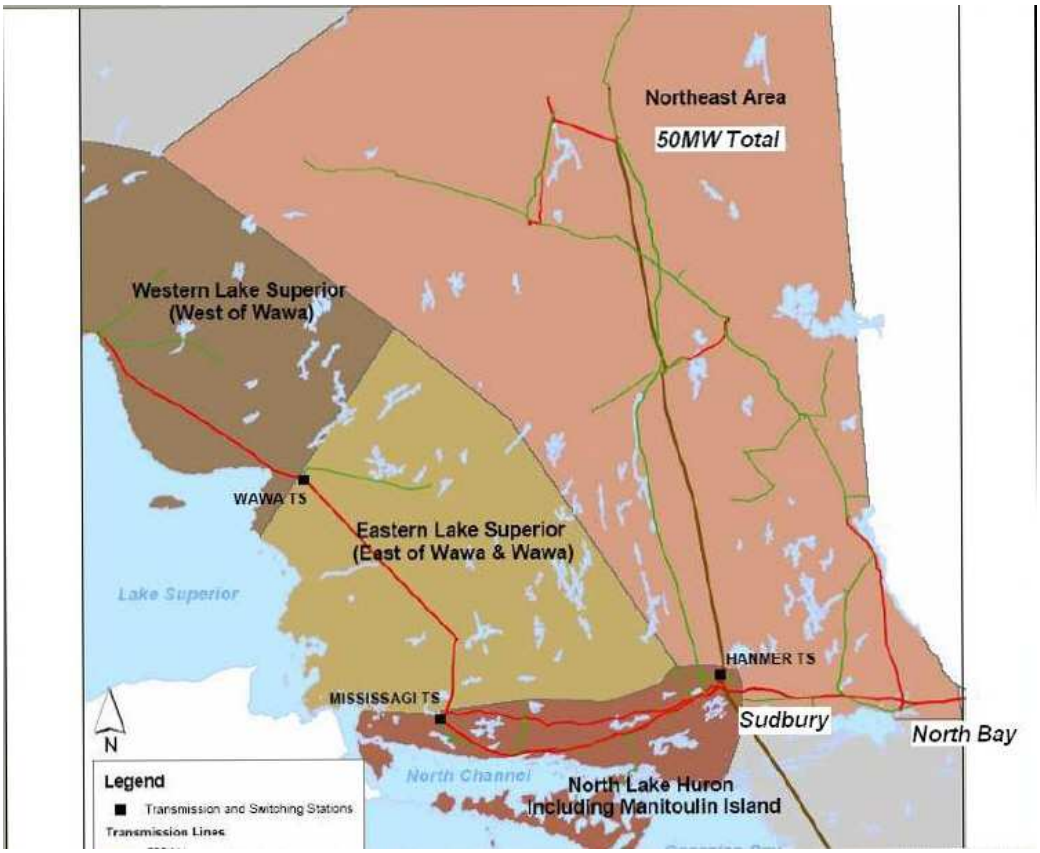
Northern WindPower Inc
755 Ski Club Rd
North Bay On
P1B 7R5
705 840 7321
705 495 0622
terrywojick@sympatico.ca
July 14, 2005

Ontario Power Authority
Supply Mix Submissions
175 Bloor St. E
North Tower, Suite 606
Toronto, On M4W 3R8

To whom it may concern

I writing this letter in response to the "Call for Written Submissions" in the North Bay Nugget posted July 13, 2005.

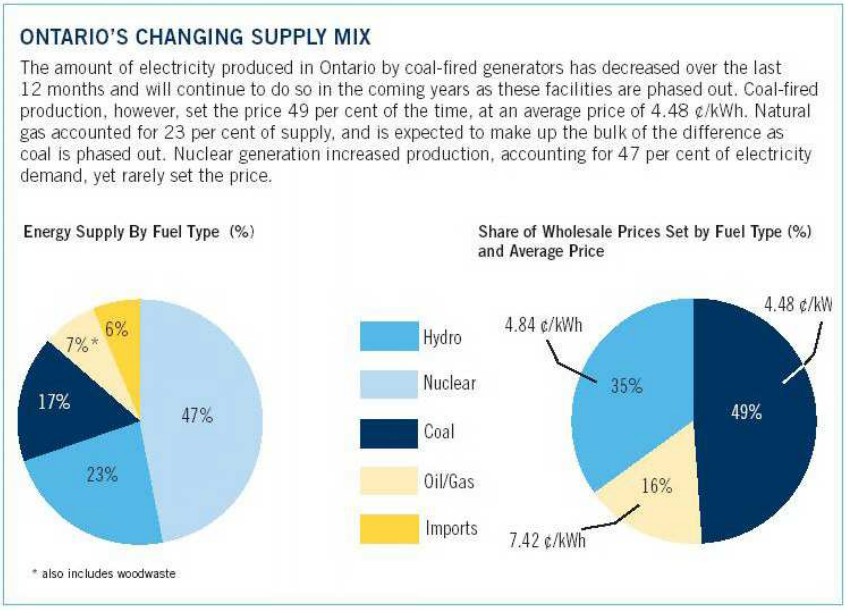
I am the president of Northern WindPower Inc based out of North Bay Ontario. To give a background on myself, I have been in the wind energy business for 3 years. My primary focus has been to identify large-scale wind power sites in Northern Ontario and then attract wind power developers to develop them. In this time, Northern WindPower has been successful in attracting two major developers to the North East area (Northern Ontario) for a total of 4 large energy projects. Recently, we have found from the IESO and the Ministry of Energy that the North East Area experiences "bottled generation" which means that the NorthEast generates more electricity then it consumes. We have reviewed the tables put forward in RFPII appendix L and were shocked to see the entire North East Area restricted to 50MW of new generation. See diagram that follows



On the other side of the Province all of Eastern, Southern and South Western Ontario has the opportunity for 4500Mw in the same RFP. In Northern Ontario we have a great potential of Water Power and possibly Wind Power, wind testing will tell of the wind resource.

Each day I read in the Local Newspaper, that Ontario is importing electricity from the United States, Manitoba and Quebec. The yearly imports total to an amount of 6% at a cost that is not disclosed (or I cannot find) on the IESO website which leads me to be believe that imports are very costly. See diagram to follow

YOUR ROAD MAP TO ONTARIO WHOLESALE ELECTRICITY PRICES


ONTARIO'S CHANGING SUPPLY MIX
The amount of electricity produced in Ontario by coal-fired generators has decreased over the last 12 months and will continue to do so in the coming years as these facilities are phased out. Coal-fired production, however, set the price 49 per cent of the time, at an average price of 4.48 ¢/kWh. Natural gas accounted for 23 per cent of supply, and is expected to make up the bulk of the difference as coal is phased out. Nuclear generation increased production, accounting for 47 per cent of electricity demand, yet rarely set the price.
Energy Supply By Fuel Type (%)
47%
23%
17%
7%*
6%
* also includes woodwaste
Hydro
Nuclear
Coal
Oil/Gas
Imports
Share of Wholesale Prices Set by Fuel Type (%) and Average Price
4.84 ¢/kWh
35%
4.48 ¢/kW
49%
16%
7.42 ¢/kWh

As a tax-payer, it does not make sense that the IESO and Ministry of energy purchases power from the United States when we have an "apparent" abundance of energy in our own province in the North East Area. I have e-mailed correspondence with the IESO to find why the reason we cannot supply energy from the North East Area to Southern Ontario due to "bottle neck" in Infrastructure. The bottle-neck is between Hanmer TS and Essa TS (Sudbury to Barrie).

I can speculate that the decrease in population and industry in the North in the past 15-20 years has created the situation of over generation in the North. Again with Southern Ontario expanding and North Ontario decreasing why isn't the province making better efforts in using this abundance of electricity in the North?

To conclude the OPA should build infrastructure to make use of the potential of renewable energy in Northern Ontario for the following reasons

- It makes sense – Southern Ontario needs energy Northern Ontario has it
- It is cost efficient – The capital cost of building infrastructure will eventually pay for itself where the cost of imports is a consumable
- And we need industry in the north – the north is desperate for new jobs to stop the migration of youth to Southern Ontario. The RFP's offer no incentive for people in the north to start up business

We urgently need new Infrastructure upgrades be it new transmission lines or Transmission station upgrade between Northern Ontario and Southern Ontario.

Terry Wojick
President Northern WindPower Inc

NORTHWATCH

August 26, 2005

Mr. Jan Carr, Chief Executive Officer
Ontario Power Authority
Supply Mix Submissions
175 Bloor Street East, North Tower, Suite 606
Toronto ON M4W 3R8

Dear Mr. Carr:

Re. Northwatch Response to Ontario Power Authority Invitation to Comment on Ontario's Electricity Supply Mix

Thank you for the opportunity to contribute to the Ontario Power Authority's deliberations as you formulate your advice to the Minister of Energy for December 1st of this year.

Northwatch is a regional coalition of community-based environmental and social development groups in northeastern Ontario. We were a full-time intervener in the environmental assessment hearing of Ontario Hydro's 25 Year Demand/Supply Plan in the early 1990's, and have also intervened in Ontario Energy Board rate reviews. Our interests are primarily related to the environmental and social concerns related to the generation and transmission of electricity, and in particular impacts and potential impacts in northeastern Ontario. Our view is that electricity planning must be integrated, must be long term, and must be governed by an environmental imperative.

We wish to bring the following points to your attention as you and your colleagues formulate advice to the Minister of Energy with respect to Ontario's electricity supply mix:

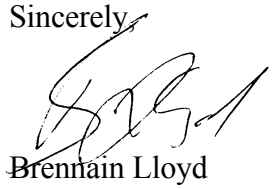
- efforts should focus on conservation; the most environmentally and economically attractive supply option is the "negawatt"
- your advice to the Minister should include advise to fast track the phasing out of nuclear power; this supply source is unreliable, uneconomical, and is associated with high levels of both short term and long term risks and adverse environmental impacts
- the reports on planning approaches, conservation and demand options, supply technologies and associated risks, and methods to assess the impacts on the natural environment of different generation options which the OPA contracted from various consulting firms last month should be the subject of public comment and extensive peer review
- the Ontario Power Authority should clarify in the immediate future their intentions and timelines with respect to the "development and management of an effective stakeholder consultation" for which the OPA issued a Request for Proposals in July but appears to have not yet awarded a contract
- the Ontario Power Authority should conduct and extensive public consultation with respect to this Province's future electricity supply mix prior to delivering your advice to the Minister; this is a matter of great concern with potentially very long lasting economic and environmental implications, and the best advice to the Minister cannot be developed in isolation from the interested public

Box 282, North Bay ON P1B 8H2 • tel 705 497 0373 • fax 705 476 7060 • www.northwatch.org • northwatch@onlink.net

In closing, we would like to commend to you - with our endorsement - the excellent study produced by the the Pembina Institute for Appropriate Development and the Canadian Environmental Law Association titled “Power for the Future: Towards a Sustainable Electricity System for Ontario" (the report can be downloaded from www.pembina.org). As summarized by the authors, this study examines the potential contributions of energy efficiency policies and low-impact renewable energy sources to meeting future electricity demand in Ontario, and finds that grid demand could be reduced by nearly 50% relative to business as usual projections through a combination of energy efficiency and demand response programs, fuel switching, and increased cogeneration. The remaining grid demand could be met through a combination of new low-impact renewable energy sources and combined cycle natural gas generating facilities. The study also finds that although an investment of over $18 billion would be required to achieve the energy efficiency savings that it identifies, energy consumers would recover 96% of this investment through reduced energy costs. In contrast, providing the same amount of energy through the construction of new nuclear generating facilities would have a capital cost of over $32 billion.

Thank you for your attention. We look forward to additional opportunities to become engaged in this important discussion as part of your efforts to formulate the best advice for the Minister of Energy.

Sincerely,



Brennain Lloyd
Northwatch

cc. Hon. Dwight Duncan, Minister of Energy

July 15, 2005

Ontario Power Authority
Supply Mix Submissions
175 Bloor St. E.
North Tower, Suite 606
Toronto, Ontario
M4W 3R8

Re: Call for Submissions on Supply Mix,

3rd "Issue Area" as stated below:

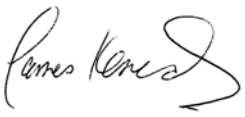
"Assessments of different supply technologies and resources in Ontario, including (but not limited to) natural gas generation, coal gasification, nuclear (new and refurbished), wind, biomass and hydro-electric resources. The assessments will be of the greatest value where they (1) utilize recent source information or current data on capital and operating costs, performance characteristics, technology life cycle, environmental impacts and any other relevant characteristics and (2) present data on a consistent basis across the supply technologies and resources suitable for planning studies."

In response to your request, this summary of microturbines answers the above stated objectives, and outlines the overall potential for microturbine-based generation.

Microturbines have become increasingly used for cogeneration, or CHP (Combined Heat & Power), throughout a wide range of sectors. Based on their size, they can fit into most facilities, displace a significant amount of the electrical load, and generate a facility's thermal requirements, be it space heating, DHW, cooling, de-humidification, etc,. The top 5 advantages are listed on the following page, accompanied by a number of case studies, technical information, and application details.

I look forward to working with the OPA and other groups to provide reliable, clean / environmentally-friendly energy to meet Ontario's needs. On Power Systems is one of the largest, independent power quality solutions provide, Capstone is the leader in microturbines with over 3500 systems installed worldwide.

Yours,



James Kennedy
On Power Systems
jkennedy@onpower.com.
Bus. 905-881-6644 ext. 27
Fax. 905-881-6652
Cell. 416-938-1871

Top 5 Capstone Microturbine Advantages

1. Microturbines generate the highest efficiencies @ 80-90%. *Due to several aspects of Capstone's design, they can better utilize its heat energy for a variety of uses, DHW, Cooling via absorption chillers, etc, thereby maximizing the system's overall efficiency.*

2. Capstone has the lowest emissions with a CARB certification (California Air Resources Board) and the SCAQMD (Southern California Air Quality Monitoring Department).

3. Capstone has the highest reliability. Capstone utilizes a single moving part design - no coolants, lubricants, gearboxes or sub-assemblies as the turbine generator spins on a single shaft air bearing at 96,000 rpm.

4. Microturbines are easy to design, integrate, finance and approve. Traditional cogen or CHP systems targeted for large industrial users, requiring large capital expenditure financed over a long time horizon, with significant engineering, approvals and an investment in other infrastructure. Microturbines represent the plug and play evolution of this application.

5. Microturbines have the highest number of potential applications. Medical, Residential, Commercial, Institutional, Industrial, Retail, IT, and Greenhouses

ON POWER SYSTEMS *35 West Pearce St. Ste. 26 Richmond Hill ON L4B 3A9 tel # 905 881 6644 fax # 905 881 6652*
James Kennedy Cell # 416-938-1871, jkennedy@onpower.com, www.onpower.com.

ONTARIO CHAMBER OF COMMERCE ESTABLISHED 1911
180 Dundas Street West, Suite 505, Toronto, Ontario M5G 1Z8
Phone: (416) 482-5222 Fax: (416) 482-5879 Web: www.occ.on.ca

August 26, 2005

Mr. Jan Carr,
Chief Executive Officer,
Ontario Power Authority
Supply Mix Submissions
175 Bloor St. E. North Tower, Suite606
Toronto, ON M4W 3R8

RE: Supply Mix Submission

Dear Mr. Carr:

The Ontario Chamber of Commerce (OCC) welcomes the opportunity to provide comment on the future energy "supply mix" for Ontario. The OCC will concentrate specifically on the issue areas identified by the Ontario Power Authority (OPA).

Reliable, clean and safe energy is one of the fundamental commodities needed for a healthy economy. To ensure that Ontario's energy demands are met, the OCC's policy goals for energy is to leave all supply options on the table and include them when developing a long term, stable regulatory framework that supports and encourages new investment, promotes efficiency, generates capacity and fosters conservation.

Conservation and Demand Management (CDM)

Exposing consumers to the true cost of power will assist in conserving energy and we applaud the government's direction in this regard.

Approaches for CDM can be enhanced primarily by shifting consumer attitudes. Initiatives targeting CDM in Ontario's energy strategy must concentrate on creating a true culture of conservation and using less power instead of merely switching to alternative energy sources.

The OCC is a strong proponent of demand side management (DSM) and recommends the implementation of initiatives such as time-of-use and smart metering. These instruments allow consumers to be proactive in managing their energy consumption. By measuring consumption and monitoring price differences throughout the day, individuals will have the incentive and the ability to control their energy costs by moving usage to off-peak periods (for example, running the dishwasher at night) or lowering energy use during peak periods (such as setting the air conditioning a few degrees warmer during the afternoon).

Ideally, the OCC would like to see the Ministry expedite the current implementation plan to have every residential and small commercial customers use smart meters. However, we recognize that with this endeavor's large price tag (estimated $1 billion), speeding up the process may prove to be a challenge. Therefore at the very least, the OPA must ensure that its target date of December 31, 2010 is not delayed. This smart metering initiative is just one step towards changing consumer mentality and is critical for long-run energy conservation.

Producing educational tools such as the *"Power Out? Energy Savings Kit"* (enclosed) demonstrates the OCC's commitment to promoting the culture of energy conservation to members and to Ontario's business community. This guide encourages businesses to reduce energy usage and explains how proactive energy measures made by individual consumers can help mitigate price increases that they may experience. It also provides Ontario businesses with information about preparing for future energy emergencies and blackouts. The OCC is also pleased to work with the OPA's Conservation Bureau and is a participant in its Conservation Challenge.

Supply Technology and Resources

Until there is an appropriate level of surplus power available to homes and businesses across Ontario, measures that encourage more supply and supply options should not be discounted.

All fuel choices have their strong points, and frankly all fuel choices have some shortcomings. A diverse supply mix and a balanced approach will ensure that Ontario's energy demands are met. The Ontario Government's decision to delay the phase-out of coal is a step in the right direction. Coal plants need to be kept in operation, while additional replacement generation and demand reduction measures are pursued.

Protecting the environment is an important factor when examining all supply options. It is also very important to ensure a portfolio of fuels is present to ensure supply diversity and price stability. Coal in particular is in abundant supply and is relatively inexpensive as a fuel source to produce electricity. It is important to note that there has been a significant reduction in emissions over the past several years due to clean coal technology and this trend is expected to continue.

Applying existing and new technology would significantly reduce emissions from Ontario's coal fleet. By retrofitting coal plants with selective catalytic reduction (SCR) units and scrubbers to remove NOx and purchasing lower sulfur coal, the coal option would readily meet the needs of the province for power production and fuel diversity.

Nuclear power currently meets more than 40 percent of Ontario's energy requirements and is emission free. It therefore represents an important component of Ontario's electrical supply mix and deserves further exploration to determine how to maximize usage from this resource.

Given Ontario's present and future power needs, now is the time to seriously consider the option of new green-field nuclear generation.

An aggressive pursuit of new green-field nuclear capacity, and refurbishing existing nuclear capabilities where and when it is economical to do so, could provide Ontario with significant amounts of clean energy to Ontario's supply mix. With relatively low operating costs and minimal maintenance requirements between long periods of operation, nuclear plants are an excellent source of reliable base load electricity.

The Ontario government's plans to increase supply of clean, renewable energy by approving new projects using waterpower, landfill gas and wind farms is encouraging as it will add diversity to the supply mix. Again, the OCC would like to see the government further explore and develop these and all other options to increase capacity.

Conclusion

A reliable and sustainable electricity system is a key element to a competitive economy. The OCC believes that the private sector has an important role in helping fulfill the province's energy supply, and therefore supports the government's RFP for private sector involvement in the power market. The power market industry can and will respond to market demands given adequate timing, clear market rules and fair rates of return. Investor confidence in the energy market will be restored once a long-term, solid, predictable energy policy (which includes private investment) is in place.

The OCC is pleased that the Minister of Energy has directed the OPA to examine Ontario's energy "supply mix" and urges the government to consider examining all possible options. If you have any questions or comments you may contact Stuart Johnston, Vice President, Policy and Government Relations, at (416) 482-5222, extension 232.

Sincerely,

Len Crispino
President and CEO

Encl: OCC *Power Out? Energy Savings Kit* Brochure

As the most diverse and most influential business group in the province, the Ontario Chamber of Commerce works closely with governments, labour, academia and various other groups to create a stronger and more vibrant economy in Ontario and the surrounding regions.

The OCC represents 57,000 members through 160 affiliated chambers of commerce and boards of trade throughout the province. The OCC has worked on behalf of business since 1911.

ONTARIO
CLEAN AIR
ALLIANCE

August 22, 2005

Dr. Jan Carr
Chief Executive Officer
Ontario Power Authority
175 Bloor Street East, North Tower, Suite 606
Toronto M4W 3R8

Dear Dr. Carr:

Re: Ontario Clean Air Alliance Supply Mix Submission

On May 2, 2005 Ontario's Minister of Energy asked the Ontario Power Authority (OPA) to provide him with recommendations with respect to electricity conservation and supply mix targets for Ontario for 2015, 2020 and 2025. To comply with the Minister's request, the OPA has indicated that it is going to analyse "different portfolios of supply sources and conservation options."

It is the Ontario Clean Air Alliance's (OCAA's) submission that, as part of this process, the OPA should analyse the benefits and costs of a conservation and supply portfolio which ensures that at least 60% of Ontario's grid-supplied electricity is provided by renewable sources by 2020 and that all of Ontario's coal and nuclear power plants are phased-out by that date.

A 2004 report by the Pembina Institute, *Power for the Future: Towards a Sustainable Electricity System for Ontario*, has shown that our proposed supply mix for 2020 is technically feasible and cost-effective. Moreover, the findings from the Pembina Institute's report are conservative since it did not analyze the potential for Ontario to meet its renewable targets by importing water-power from Manitoba, Quebec or Labrador.

In particular, the OCAA recommends that the OPA analyze the benefits and costs of the following options to ensure that Ontario obtains at least 60% of its grid-supplied electricity from renewable sources by 2020:

1. Raising the price of electricity up to its full (incremental or marginal) cost and providing the excess revenues to the Government of Ontario to finance public services (e.g., schools, hospitals) and/or deficit reduction.

625 Church Street, Suite 402 Toronto, Ontario M4Y 2G1
Tel: 416.926.1907 ext 240 • Fax: 416.926.1601
E-mail: info@cleanairalliance.org Web Site: www.cleanairalliance.org

2. Programmes and policies to ensure that low-income consumers are not disadvantaged as a result of higher electricity prices. For example, aggressive conservation and electric space heating fuel switching programmes that will reduce the energy bills of low-income consumers. These programmes could be supplemented by lump sum annual electricity bill rebates for residential consumers (X dollars per electricity ratepayer irrespective of her annual electricity consumption).
3. An aggressive demand response programme that pays large industrial and commercial customers, electric utilities and market aggregators the same price per kWh for demand reductions (a negawatt) that the IESO pays electricity generators for supply during peak demand periods.
4. The aggressive promotion of energy conservation by Hydro One and Ontario's municipal electric utilities.
5. Stricter minimum energy efficiency standards for new buildings, appliances and electric motors.
6. OPA procurement of made-in-Ontario renewable electricity supplies.
7. OPA procurement of water-power supplies from Manitoba, Quebec and Labrador. Ontario has the potential to import more than 5,000 MW of clean power from Manitoba. Five thousand megawatts is equivalent to 46% of Ontario's existing installed nuclear generation capacity. Moreover, if Quebec were to aggressively promote energy conservation, it could free up significant electricity supplies from its existing water power generating stations for export to Ontario.
8. A standard offer price for natural gas and biomass-fired combined heat and power projects. According to a report prepared for the Ontario Ministry of Energy, Ontario's total combined heat and power potential in 2020 is 16,514 MW (Hagler Bailly Canada, *Potential for Cogeneration in Ontario: Final Report,* August 2000, p. 25). This is equivalent to 95% of Ontario's existing installed coal and nuclear generation capacity.
9. A competitive bidding process for additional natural gas-fired combined-cycle power plants.

Should you require any clarification with respect to our submissions, please do not hesitate to contact me.

Yours sincerely,

Jack Gibbons
Chair

Phasing Out Coal:

15-Month Progress Report

Ontario Clean Air Alliance

JANUARY 20, 2005

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About the Ontario Clean Air Alliance

The Ontario Clean Air Alliance (OCAA) is a coalition of health, environmental and consumer organizations, municipalities, utilities, faith communities, unions and individuals working for cleaner air through strict emission limits and the phase-out of coal in the electricity sector. Our partner organizations represent over six million Ontarians.

Acknowledgments

The OCAA gratefully acknowledges the generous financial support of the Laidlaw Foundation and the Toronto Atmospheric Fund.

The OCAA can be contacted at:
Ontario Clean Air Alliance
625 Church Street, Suite 402
Toronto M4Y 2G1
Tel: (416) 926-1907 ext. 245
Fax: (416) 926-1601
E-mail: info@cleanairalliance.org
Web Site: www.cleanairalliance.org

This report was written by Jack Gibbons

Cover photograph of Lakeview coal plant by Karen Smith

Introduction

Since taking office in October 2003, the McGuinty government has strongly reiterated its commitment to a complete coal phase-out by 2007. The OCAA's first assessment of the government's progress toward meeting this important goal for improving health and air quality in Ontario (Phasing Out Coal: Six Month Progress Report) found that the government was lagging in implementing the actual policy measures that would allow for a non-disruptive phase-out.

In the past six-to-nine months, this situation has changed dramatically with the government moving forward with a number of key initiatives, such as securing new supply and making local utilities leaders in conservation, that will be crucial to ensuring that Ontario can meet its energy needs cleanly and efficiently after the coal-plant shutdown.

However, during this period the government also become sidetracked with a decision to approve the restart of the Pickering A Unit 1 nuclear generating unit. The underperformance of Ontario's aging and unreliable nuclear fleet was a key contributor to the 120% surge in the use of dirty coal power between 1995 and 2003. Banking on high- cost nuclear energy to continue to meet Ontario's future power needs could -- if it continues to be pursued despite the overwhelming evidence of the inefficiency of this investment – jeopardize a sustained coal shutdown.

The major lessons of the past period are that Ontario is not facing an energy supply crisis as a result of its commitment to shut down its highly polluting coal-fired generating stations. In fact, the response to the government's requests for proposals for both renewable energy and clean conventional power has been so robust that the province is in an ideal position to increase its uptake from both sources -- rather than from costly nuclear restarts -- to meet its current and future needs.

As well, the potential for greater efficiency and conservation and the contribution that this can make to providing a cleaner, healthier and more economically competitive future for the people of Ontario is also becoming clear with the transformation of local utilities into conservation agents. Given that Ontario's per capita energy consumption remains close to 60% higher than neighbouring New York State's, the potential gains to be made in this area are clearly enormous.

Progress has come on all fronts at a very timely juncture: The Lakeview coal-fired generating station on the Toronto Waterfront – the No. 1 industrial source of air pollution in the Greater Toronto Area – is scheduled to be shut down on April 30, 2005. This will be the first step in turning the coal phase-out from rhetoric to reality.

While there is still work to be done, including creating better incentives for peak load shifting and conservation, Ontario is now well on its way to a brighter energy and air quality future.

Recommendations for next steps in this report:

Ensuring a smooth phase-out:

- Direct the Ontario Power Authority (OPA) to develop an aggressive demand response program, which could reduce Ontario's peak-day demands by at least an additional 1,350 MW by 2007.
- Direct the OPA to obtain at least another 1,000 MW of renewable supply through a competitive bidding process.
- Direct the OPA to obtain up to another 3,200 MW of clean new supply either from suppliers who responded to the previous request for proposals for 2,500 MW of clean new supply and/or by converting OPG's Lambton Station to natural gas.
- Exempt all new renewable and natural gas cogeneration projects from the province's 0.7 cent per kWh nuclear debt retirement charge.
- Direct the OPA to establish standard offer prices for small scale (10 MW or less) renewable and cogeneration projects and order it to enter into electricity supply contracts with any suppliers willing to accept the standard offer price.
- Ensure that any deal with Bruce Power is competitive with prices determined through the competitive bidding process and that it contains the same contract terms as for other large independent power suppliers.

Keeping coal plants shutdown:

- Direct the Ontario Power Authority to ensure that Ontario's non-coal generation capacity exceeds Ontario's normal weather-driven peak-day demands by at least 16% commencing January 1, 2008.
- Pass a regulation stating that Ontario's coal-fired

power plants can only be re-started post December 31, 2007 if the Independent Electricity System Operator determines that a coal re-start is absolutely essential to keep the lights on in Ontario.

- Direct the Ontario Power Authority to develop a post-2007 emergency response strategy to acquire the additional energy conservation, renewable and natural gas-fired generation resources that are necessary to ensure that the duration of any coal re-start is as short as possible.

Overview of current situation

The use of coal declined significantly in 2004 due to the availability of new power supplies, but the Ontario Energy Minister also recently warned that the unreliability of Ontario's nuclear stations could hamper the long-term sustainability of the coal phase-out.

Coal-Fired Generation Falls by 23%

In 2004, Ontario's coal-fired electricity generation fell by approximately 23% relative to 2003. In 2004, Ontario's coal-fired electricity generation was approximately 28 billion kilowatt hours (kWh) compared to 36.255 billion kWh in 2003.[1] This meant that in 2004, our coal-fired power plants produced approximately 18% of Ontario's electricity. In 2003, OPG's coal-fired generation was responsible for approximately 24% of Ontario's power supply.[2]

Part of the reason for this decline in coal use was the availability of new supply from cleaner and more efficient sources. In total, more than 600 MW of new natural gas-fired generation capacity was brought online in 2004, with the commissioning of Ontario Power Generation's [OPG's] Brighton Beach power plant in Windsor (580 MW) and Northland Power's plant in Kirkland Lake (32 MW).[3]

Commitment to 2007 Coal Phase-Out

As the government tracks toward the April 2005 shutdown of the Lakeview coal-fired generating station on the Toronto waterfront, it remains committed to a full phase-out by 2007.

On Dec. 1, 2004, Energy Minister Dwight Duncan told the legislature:

> "Lakeview will be the first coal-fired station to close. I can confirm . . . that it will close on or before April 30, 2005, as per plan "[3b]

On Dec. 13, 2004, Energy Minister Dwight Duncan told the legislature:

> "Our government remains committed to replacing coal-fired generation, and we will identify the cleanest, most affordable potential power sources in Ontario as replacements for coal. We believe it's important to clean up this province's air quality. We're concerned about the CO_2 emissions from coal. We're concerned about mercury and particulates. We're concerned about the levels of childhood asthma we've seen in this province. We're concerned that we have had smog days in Algonquin Park and Sault Ste Marie."[3c]

On Dec. 14, 2004 the Minister reiterated that:

> "It's our corporation that owns that coal-fired generation, and we've made a commitment to replace it with cleaner, more efficient power by 2007. Our undertakings are aggressive - we acknowledge that - but this government believes that we can clean up the air. We can set an example for the Americans."[3d]

However, in November 2004, Minister Duncan acknowledged that it may be necessary post December 31, 2007 to temporarily re-start the Nanticoke coal-fired power plant to keep the lights on in Ontario if a nuclear power plant unexpectedly "conked out".[4] Minister Duncan's caveat reflects the fact that Ontario obtains more than 40% of its electricity from unreliable nuclear power plants.

- According to the International Energy Agency, "Canadian nuclear reliability for the period 1990 - 2002 has been the worst in the OECD".[5]
- The annual utilization rates of Ontario's nuclear power plants declined from 80% between 1980 and 1983 to 51% in 2003.[6]
- As a result of Ontario's heavy dependency on unreliable CANDU nuclear reactors, it took Ontario more than eight days to fully recover from the August 14, 2003 blackout versus less than two days for New York state.[7]
- Due to the declining performance of Ontario's nuclear reactors, OPG had to increase the output of its dirty coal-fired power plants by approximately 120% between 1995 and 2003 to keep the lights on in Ontario.[8]

The government will need to address the uncertainty created by the province's aging nuclear system to ensure a smooth coal phase-out. See page 11 for more details on this issue.

Progress toward a full phase-out

The government has moved into much more of an action phase in the last six-to-nine months and is now well advanced in setting the stage for a coal phase-out. In particular, it has created a strong policy framework for the promotion of conservation and has received a strong response to its request for proposals for new supply.

Creating Over 90 Conservation Utilities

The government is transforming Ontario's 90-plus municipal electric utilities (e.g., Hydro Ottawa, Toronto Hydro) and Hydro One into conservation utilities.

On November 25, 2003 Energy Minister Duncan announced that Ontario's municipal utilities and Hydro One will be permitted to raise their rates by $225 million, effective March 1, 2005, to finance their initial energy conservation budgets.[9] If the electric utilities' initial energy conservation programs are as effective as those of Enbridge Gas Distribution, they will reduce their customers' bills by $1.6 billion.[10]

In an April 15, 2004 speech to the Empire Club, Minister Duncan stated that Ontario's electric utilities (also known as local distribution companies – LDCs) will play a key role in building a "conservation culture in Ontario":

> "Our sector reforms would also support conservation at the local level. The Ontario Energy Board would also establish a framework to help local distribution companies deliver energy conservation programs as appropriate. The current disincentives for local distribution companies would be removed, and LDC's would benefit from empowering their customers to conserve electricity and making their own systems more efficient.
>
> We believe that LDCs can and should be agents of change at the local level to promote conservation. LDCs are extremely well placed to encourage conservation and energy efficiency in the communities they serve, and we will need all their expertise, ingenuity and leadership to help build that conservation culture in Ontario."[11]

Historically the Ontario Energy Board's (OEB's) regulatory rules have financially penalized electric utilities that reduce their customers' bills by increasing their energy efficiency. Because the OEB's rules linked the electric utilities' profits to their electricity sales, energy conservation programs that reduced electricity consumption also reduced the utilities' profits.

On December 7, 2004, in response to a motion by Pollution Probe, the OEB made the promotion of energy conservation a profitable course of action for Ontario's electric utilities by establishing Lost Revenue Adjustment Mechanisms (LRAMs) and Shared Savings Mechanisms (SSMs).[12]

The LRAMs allow the utilities to recover revenues and profits lost due to their energy conservation programs. Specifically, the LRAMs make the utilities revenue and profit neutral with respect to the promotion of energy conservation.

The SSMs provide the utilities with a small fraction (i.e., 5%) of the total bill savings achieved by their conservation programs as a profit bonus. For example, if Toronto Hydro's energy conservation programs reduce its customers' bills by $100 million, Toronto Hydro will get a $5 million profit bonus.

This is a win-win proposition since it will lead to larger net bill savings for the customers and higher profits for Ontario's electric utilities. These higher profits can be passed on to their shareholders (provincial and municipal governments) to pay for public services (e.g., schools, hospitals, parks, public transit).

The Beck Tunnel

On June 25, 2004, Energy Minister Duncan announced that the government was directing OPG to expand the output of its Sir Adam Beck Generating Station by building another tunnel under the City of Niagara Falls.

The increased supply of 100% pollution-free electricity from Sir Adam Beck will be equivalent to approximately 60% of the output of the Lakeview coal-fired power plant in Mississauga.[13] Its cost will be approximately 3.1 cents per kWh.[14] The tunnel is expected to be completed by 2009.[15]

Green Power Contracts

On November 24, 2004 Energy Minister Duncan announced that as a result of its competitive bidding process for new renewable electricity supplies, the government has signed contracts with power producers for 10 new green power projects. The projects include:

- Umbata Falls Hydroelectric Project, a partnership of the Pic River First Nation and Innergex III Income Fund;
- Trail Road Landfill Gas Generating Station, Hydro Ottawa;
- Eastview Landfill Gas Energy Plant, Guelph Hydro; and
- Five wind farms to be operated by Erie Shores Wind Farm, Superior Wind Energy, Canadian Hydro Developers and EPCOR.[16]

The new supply from these projects will be equivalent to approximately 40% of the output of the Lakeview coal-fired power plant.[17]

As Figure 1 reveals the cost of these new green power supplies, 8 cents per kWh[18], is less than the total cost of nuclear power.

Fig. 1

Cost Comparison: Nuclear Power, New Renewables and Pickering A Re-Start

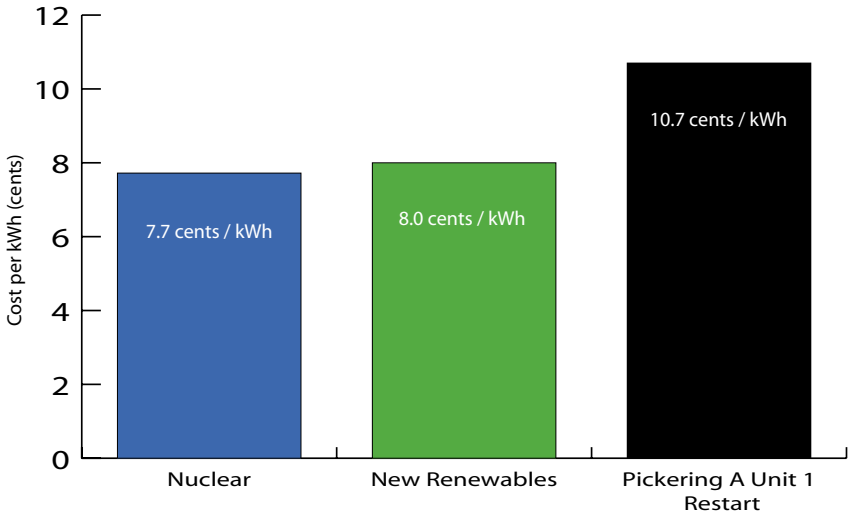


Figure 1 compares the cost of producing electricity from Ontario Hydro's nuclear power plants in 1998[19]; the cost of the new renewable electricity supplies from the independent power producers; and our estimate of the cost of re-starting the Pickering A Unit #1 nuclear reactor.[20]

The nuclear power costs do not include the costs of decommissioning Ontario's nuclear reactors and the costs associated with the long-term storage of radioactive nuclear wastes. In addition, the former Ontario Hydro's and Ontario Power Generation's nuclear costs have been artificially lowered by the Nuclear Liability Act which limits their liability in the event of a nuclear accident to $75 million.

Competitive Bidding Process for 2,500 Megawatts of Clean New Electricity Supply or Conservation Measures

In response to its competitive bidding process for 2,500 megawatts of clean new supplies or conservation measures, the government has received 33 proposals representing 8,268 megawatts (MW) of new electricity generation capacity or electricity conservation measures.[21] This proposed new generation and conservation capacity of 8,268 MW easily exceeds Ontario's total coal-fired generation capacity of 7,564 MW.[22] The winning proposals will be announced in February 2005.[23]

It is interesting to note that the government has not received a proposal for new nuclear supplies through the competitive bidding process. This is an implicit admission by the nuclear power industry that nuclear power is not cost-competitive with high-efficiency natural gas-fired generation or conservation measures.

Two-tier Electricity Rates

Effective April 1, 2004, the government raised the electricity commodity charge for small volume consumers from 4.3 cents per kWh to 4.7 cents per kWh for the first 750 kWh of consumption per month and to 5.5 cents per kWh for all consumption in excess of 750 kWh per month. This means that the electricity commodity charge, which represents approximately 50% of the cost of electricity for residential consumers, has been raised by 9-28%. These more realistic electricity rates will help to promote a conservation culture in Ontario.

Smart Meters

On April 19, 2004, Premier McGuinty announced that he will direct the Ontario Energy Board to develop a plan to install smart meters in 800,000 homes by 2007 and in all Ontario homes by 2010.[24]

Smart meters, by permitting time-of-use pricing, will provide residential consumers with an incentive to shift some of their electricity consumption from peak to off-peak periods. This will reduce the need for expensive new electricity generation, transmission and distribution infrastructure.

Net Metering

The Government has issued a proposed net metering regulation that would require all of Ontario's electric utilities to establish net metering for all green power generation facilities (e.g., water, wind, solar power, farm biomass) of up to 500 kW. Net metering will allow small green power producers to feed power into the provincial electricity grid and receive a credit. (Small producers will be credited on a net-consumption basis, which means the amount of power they feed into the grid will be deducted from any power they are charged with using from the grid during periods when their own production does not meet their needs. They will not be paid for any power they feed into the grid that exceeds their overall consumption from the grid.)

Many customers are interested in generating electricity for their own use from renewable sources. However, their consumption profiles will rarely match their generation profiles – in other words, they may need power (such as at night) when their system (such as a solar panel) is least able to produce it. Net metering makes it much more practical for such customers to invest in renewable systems, because it eliminates the need for relatively inefficient battery storage systems and allows users to meet only a part of their needs with their own systems. Net metering will result in an increase in clean self-generation and thereby help to phase-out the dirty coal-fired power plants.[25]

Creation of Ontario Power Authority

In December 2004, the government created the Ontario Power Authority, an agency of the Government of Ontario, which will ensure an adequate long-term supply of electricity by entering into contracts with independent power producers (e.g., energy co-ops, municipal utilities, hospitals, shopping centres, manufacturing companies and investor-owned power companies) for electricity supply.[26] The authority also has a mandate to meet Ontario's energy needs through conservation measures on an equal basis with new supply.

The creation of the Power Authority is important for the orderly acquisition of new supply and the implementation of aggressive and coordinated conservation measures. By issuing long-term contracts, it will provide the certainty necessary for long-term investments in Ontario's electricity system.

Missteps

Most of the government's missteps have involved decisions to spend hundreds of millions of dollars propping up Ontario's failing nuclear system. Over the same period that the government has approved new nuclear spending -- despite the sector's history of cost overruns and delays -- its own initiatives have resulted in a tremendous response from other more reliable power producers offering new, less costly supply options.

OPG Review Committee

On December 16, 2003, Energy Minister Duncan announced the establishment of the OPG Review Committee to make recommendations on "the potential refurbishing of Pickering A Units 1, 2 and 3." The Minister appointed the Hon. John Manley as Chair of the OPG Review Committee despite the fact that Mr. Manley had no known expertise on energy issues. In addition, the Minister appointed Jake Epp to the committee, despite the fact that, as Chair of OPG, Mr. Epp was in a direct conflict-of-interest position.[27]

On March 15, 2004, the committee issued its report, Transforming Ontario's Power Generation Company, which recommended that the Pickering A Unit #1 nuclear reactor be re-started.[28] According to the committee, the total cost of the re-start would be $825 million.[29] Subsequent events have revealed that this estimate was overly optimistic.

The committee also concluded that re-starting Pickering A Unit #1 was a lower cost option to phase-out coal and keep the lights on in Ontario than building a new, high-efficiency natural gas-fired power plant.[30]

The committee's conclusions were based on an economic spreadsheet model that was developed by OPG.[31] A review by the OCAA found that this spreadsheet model contained at least four key assumptions that were not factually reliable. When the spreadsheet was re-calculated by the OCAA with more realistic assumptions, it revealed that the cost of the Pickering A Unit #1 re-start will be 10.7 cents per kWh versus a cost of approximately 6 cents per kWh for obtaining electricity from a new natural gas-fired power plant.[32]

Finally, the committee failed to note that according to its economic advisors, CIBC World Markets, the Pickering re-start is uneconomic on a total cost basis.[33]

Pickering A Re-Start

On July 7, 2004 Energy Minister Duncan announced that the Government of Ontario had approved the re-start of the Pickering A Unit #1 nuclear reactor.

According to Minister Duncan:

- The re-start would cost $900 million or 9% more than the OPG Review Committee's estimate of $825 million. However, the Minister assured Ontarians that "Rigorous public scrutiny will ensure that the project stays on track and on budget."[34]
- The Minister also stated that "As part of this restart project, we have already directed OPG to provide regular updates to the public on the progress of the project, tied to specific and clearly articulated milestones . . ."[35]
- The Minister contended that "The return to service of Pickering A, Unit 1, is the shortest lead-time major supply project available in Ontario, and is crucial to ensure a clean, diverse and reliable electricity supply in the coming years."[36]

Unfortunately, none of the Minister's statements were accurate.

- On November 15, 2004, OPG admitted that the Pickering A re-start was already $75 to $100 million over budget.[37] That is, OPG is estimating that its total cost will now be $975 to $1 billion.
- While OPG has identified a number of engineering milestones for the re-start, it has refused to provide its July 7, 2004 forecast of its total cumulative expenditures on the re-start as of each of its milestone dates. OPG has denied the Ontario Clean Air Alliance's Freedom of Information request for this information on the grounds that providing this information "could cause commercial harm" to OPG.[38]
- If instead of directing OPG to re-start Pickering A, the Minister had directed it to convert the Lakeview Generating Station's coal boilers to burn natural gas, he would have been endorsing a project with a shorter lead time, greater reliability and more supply (1140 megawatts versus 515 megawatts for Pickering A Unit #1). This action would also have made Ontario's electricity system more diverse (currently, Ontario obtains only approximately 7% of its electricity from natural gas versus more than 40% from nuclear power).

Finally, the cost of converting Lakeview to natural gas would be only $23 to $68 million – less than the amount of the Pickering cost overrun to date alone.[39]

Bruce Power Special Deal

As noted earlier, the refusal of Bruce Power – the only privately owned nuclear power operator in the province -- to participate in the government's competitive bidding process for 2,500 megawatts of new clean electricity supplies was an implicit admission that its proposal to re-start its shutdown nuclear reactors is not competitive with new high-efficiency natural gas-fired power plants in terms of price and reliability. Nevertheless, on September 8, 2004, the Government of Ontario announced that it has agreed to begin discussions to negotiate a special deal with Bruce Power.[40]

A special deal with Bruce Power will not be in the best interests of the people of Ontario if:

- its cost are greater than the cost of natural gas-fired electricity as determined by the government's competitive bidding process; or
- the poor performance of the re-started Bruce units increases the risk of a blackout or requires a re-start of the Nanticoke coal-fired power plant post December 31, 2007 to keep the lights on in Ontario.

In order to protect Ontario's consumers, public health and the environment, the government must ensure that any deal for Bruce Power contains the following conditions:

- Caps the province's annual purchase price for nuclear power at its annual purchase price for electricity as determined by its competitive bidding process for 2,500 megawatts of new supply.
- If Bruce Power fails to achieve its milestone date for returning its shutdown units to commercial operation, Bruce Power should be required to pay the government up to $300 per megawatt of contracted capacity, per day, for each day after the milestone date until commercial operation is achieved.
- Permits the government to terminate its contract with Bruce Power if the company is more than 18 months late in returning its nuclear units to service or it the units fail to achieve annual capacity utilization rates of 70% during the second contract year; 75% during the third contract year; and 80% during the fourth and each succeeding contract year; and
- Requires Bruce Power to pay the province's incremental cost of obtaining replacement power for the duration of the original contract term if the province terminates the contract for one of the above-noted reasons.

The second-through-fourth conditions noted above are identical to the proposed terms for the government's contracts with independent power producers for electricity secured through its 2,500 megawatt competitive bidding process.[41]

Achieving a 2007 Coal Phase-out: What Still Needs to Be Done

In 2004, OPG's five coal-fired power plants had a peak-day capacity of approximately 7,500 megawatts (MW) and produced approximately 28 billion kWh of electricity.

Table 1 below shows the new peak-day capacity and annual electricity generation potential that will be available in 2007 as a result of the McGuinty government's actions to date.

Table 1

Additional Capacity Secured To-Date

	Peak Day Capacity (MW)	Annual Electricity Generation Potential (kWh)
Pickering A Unit 1	515	3.4 billion[42]
Green Power Contracts	Information not currently available[43]	1.2 billion[44]
2,500 MW of Clean New Electricity Supply or Conservation Measures	2,500	19.7 billion[45]
Total	**3,015**	**24.3 billion**

As Table 1 indicates, the McGuinty government's actions will provide Ontario with the ability to produce approximately 24.3 billion kWh per year of replacement power by 2007 This is equivalent to approximately 87% of the output of Ontario's coal-fired power plants in 2004. However, these actions will only provide Ontario with approximately 40% (3,015 MW – on the unlikely assumption that green power suppliers do not provide any peak power) of the peak-day capacity that is needed to fully replace the peak-day capacity of Ontario's five coal-fired power plants (approximately 7,500 MW).

Closing the gap

The key additional steps that the government should take during the next six months to obtain the additional 3.7 billion kWh of electricity generation and 4,550 MW of capacity necessary to phase-out our dirty coal-fired power plants by 2007 are the following:

Demand Response

Paying customers to reduce their demand during periods of system peak demand can provide significant benefits to Ontario, including:

1. Reduced need for new electricity generation and transmission infrastructure.
2. A dramatic reduction in the spot price of electricity. For example, according to National Economic Research Associates, a 2–5% reduction in demand on peak days could reduce spot prices by 50% or more.[46]
3. Reduced risk of blackouts and brownouts.

The Independent System Operator New England (ISO New England), the New York Independent System Operator (NYISO) and the Pennsylvania-New Jersey-Maryland Interconnection (PJM) have all established demand response programs that pay their customers to reduce demand during periods of system peak demand and/or supply shortages. For example, ISO New England pays its customers up to $1 per kWh to reduce demand during peak periods.[47] According to ISO New England:

> "Demand response participants provide an important resource for New England. They help ensure the power grid's reliability, reduce wholesale price volatility that drives up the cost of power for everyone, and reduce air pollution by enabling older, less efficient power plants to run less often."[48]

The government should therefore direct the Ontario Power Authority to develop an aggressive demand response program, which could reduce Ontario's peak day demands by at least an additional 1,350 MW by 2007.[49]

More Renewable Power

The Ontario Power Authority (OPA) should issue a Request for Proposals for at least 1,000 MW of additional renewable power.

A competitive bidding process is the best option to obtain renewable power from large investor-owned power companies. However , for individuals, farmers and local community organizations interested in developing small renewable power projects, participating in the OPA's competitive bidding processes is simply not feasible (too costly and complex given their likely returns).

Therefore, to facilitate the development of small-scale (10 MW or less) projects, the OPA should establish standard offer prices for these projects and should enter into electricity supply contracts with all small-scale renewable projects that are willing to accept the standard offer price. Prices determined by the competitive bidding processes should be used as benchmarks to establish the standard offer price, which could then be adjusted to recognize the added benefits of small, geographically diverse renewable supplies.

More Clean Power

The Ontario Power Authority will need to obtain up to an additional 3,200 MW of supply capacity to make way for the complete phase-out of all of Ontario's coal-fired power plants by 2007. This additional capacity can be obtained by entering into additional supply contracts with independent power producers; by directing OPG to convert some or all of the Lambton Generating Station's coal-fired boilers to natural gas; and/or by encouraging power consumers to self-generate some or all of the electricity required to meet their needs.

Increase uptake from independent producers

As we have noted above, the government has received 33 proposals totaling 8,268 MW of capacity in response to its 2,500 MW Request for Proposals. Therefore these proposals alone already provide the OPA with a potential extra 5,768 MW of new clean supply capacity – almost twice what is required.

Convert Lambton

The Lambton coal-fired power plant, near Sarnia, has four boilers with a total capacity of 1,975 MW. According to the Ontario Ministry of the Environment, the capital cost of converting these boilers to burn natural gas would be approximately $40 million to $120 million.[50] The Lambton plant is ideally located to meet peak day demands since it is near an existing high-pressure natural gas pipeline, Union Gas' natural gas storage facilities and major industrial power consuming loads (e.g., Chemical Valley).

Encourage self-generation

Currently, companies and institutions that meet some or all of their electricity requirements from renewable sources and natural gas are required to pay the province 0.7 cents for each kWh that they self-generate in order to help payoff Ontario's $20 billion stranded nuclear debt. This charge is a significant and perverse market barrier to the development of some of our lowest cost new electricity supply sources. Therefore the province should exempt all new renewable and natural gas cogeneration power projects from this charge.

To facilitate the development of small-scale (10 MW or less) natural gas-fired combined heat and power (cogeneration) projects, the OPA should establish standard offer prices for these projects and enter into electricity supply contracts with all small-scale natural gas-fired combined heat-and-power projects that are willing to accept the standard offer price. Such projects would be well suited to a variety of institutions, from hospitals and schools to shopping malls and factories, and could contribute significantly to reducing demand while also providing some new supply.

Additional capacity available

Table 2 summarizes the additional capacity and electricity generation resources that would be provided by the previously noted measures.

Table 2
Additional Capacity Available

	Peak Day Capacity (MW)	Annual Electricity Generation Potential (kWh)
At least 1,350 MW of Additional Demand Response	1,350	0[51]
At least 1,000 MW of Additional Renewable Capacity	Unknown	3 billion[52]
Up to 3,200 MW of Additional Clean Electricity Generation Capacity*	Up to 3,200	Up to 25.2 billion[53]
Total	**Up to 4,550**	**Up to 28.2 billion**

*of which up to 1,975 MW can be obtained by directing OPG to convert its Lambton Generating Station from coal to natural gas

Keeping Nanticoke shutdown

Minister Duncan has warned that due to the unreliability of Ontario's nuclear fleet, the government believes there is a possibility that the Nanticoke plant may need to be temporarily restarted after the full coal shutdown takes effect.

The government should take the following actions to minimize the likelihood and duration of a temporary Nanticoke re-start after Dec. 31, 2007.

1. Direct the Ontario Power Authority to ensure that Ontario's non-coal generation capacity exceeds Ontario's normal weather-driven peak-day demands by at least 16% commencing January 1, 2008.
2. Pass a regulation stating that Ontario's coal-fired power plants can only be re-started post December 31, 2007 if the Independent Electricity System Operator determines that a coal re-start is absolutely essential to keep the lights on in Ontario.
3. Direct the Ontario Power Authority to develop a post-2007 emergency response strategy to acquire the additional energy conservation, renewable and natural gas-fired generation resources that are necessary to ensure that the duration of any coal re-start is as short as possible.

In the longer term, the best solution is to replace Ontario's unreliable nuclear units with more reliable natural gas and renewable sources combined with aggressive conservation measures.

After 2007: Maintaining the Coal Phase-out

The Government of Ontario must also implement policies and programs that will ensure that the coal phase-out can be sustained as Ontario's 10,831 MW of existing nuclear generating capacity is retired between 2009 and 2020 while enabling Ontario to obtain 100% of its electricity supply needs from ecologically sustainable renewable sources as soon as possible.

2008 to 2014 – Nuclear begins to fade

According to the Independent Electricity Market Operator (IMO), 2,317 MW of nuclear generation will be removed from service between 2008 and 2014. Specifically, Bruce A Unit 3 will be removed from service beginning January 1, 2009 and the Pickering B Units 5, 6 and 7 pressure tubes reach the end of their lives by 2013.[54]

Assuming the energy conservation policies of the OPA and Ontario's electric utilities simply maintain electricity consumption at today's levels, the retirement of 2,317 MW of nuclear capacity will require the addition of 386 MW of new capacity per year between 2008 and 2014. On the other hand, if these programs actually reduce Ontario's total electricity consumption, the need for new capacity could be substantially reduced.

The required new capacity could be obtained over this time period from some or all of the following options.

1. The Beck Tunnel at Niagara Falls, which is forecast to be in service by 2009.
2. Additional Ontario wind, water, solar and biomass projects developed by energy co-operatives, municipal utilities and investor-owned power developers.
3. New natural gas-fired combined heat and power (co-generation) projects.

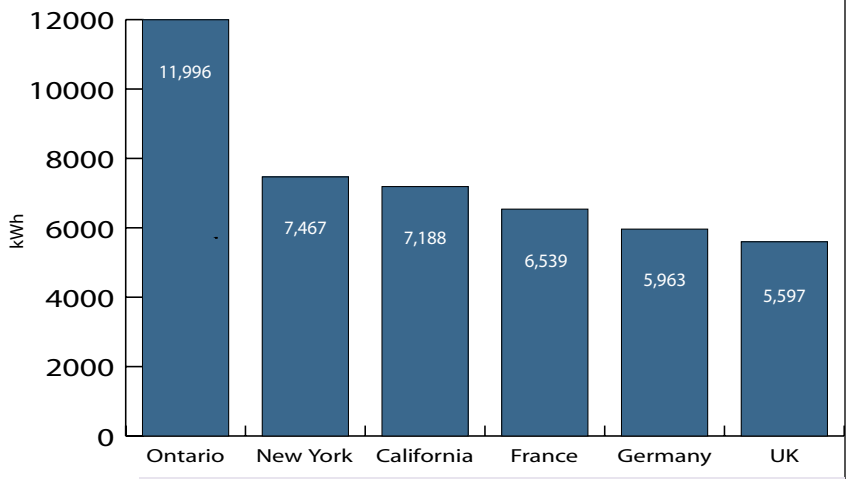
2015 to 2020 – Nuclear fades to black

According to the Independent Electricity Market Operator, on December 31, 2014 Ontario will have 9,029 MW of remaining nuclear capacity.[55] However, according to the Electricity Conservation and Supply Task Force, by "about 2020, virtually all of the Province's existing nuclear plants will reach the end of their planned operating lives, and need to be refurbished, replaced, or retired."[56]

Assuming the energy conservation policies of the OPA and Ontario's electric utilities simply maintain Ontario's total electricity consumption at today's levels, 9,029 MW of new supply (1,505 MW per year) will be required between 2015 and 2020 to replace the remaining nuclear capacity that will be going out of service.

On the other hand, there is the potential for Ontario to greatly increase its energy efficiency by 2020. As Figure 2 indicates, Ontario's per capita electricity consumption is dramatically higher than that of many other industrial societies. For example, Ontario's per capita electricity consumption is 60% greater than that of New York State.

Fig. 2
Annual electricity consumption (kwh) per capita in 2000



France, Germany & UK: http://devdata.worldbank.org/data-query

California: In 2000 California's total electricity consumption was 832.7 trillion Btu and its population was 33,871,648. URL: http://www.eia.doe.gov/emeu/states/sep_sum/html/rank_use_per_cap.html; and http://www.census.gov/main/www/cen2000.html.

New York State: In 2000 New York State's total electricity consumption was 484.6 trillion Btu and its population was 18,976,457. URL: http://www.eia.doe.gov/emeu/states/sep_sum/html/rank_use_per_cap.html; and http://www.census.gov/main/www/cen2000.html.

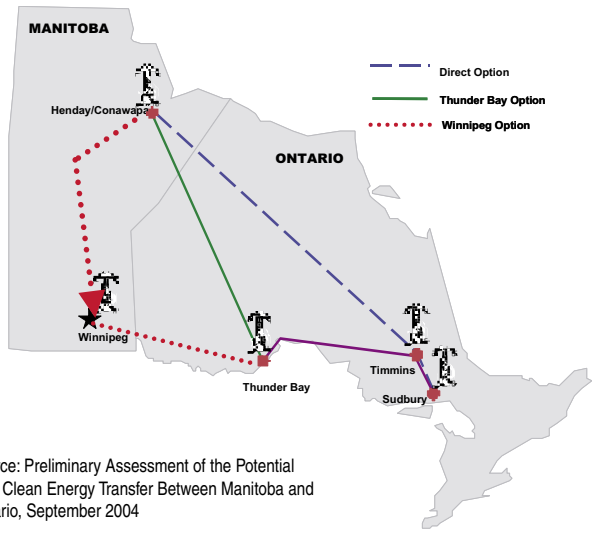
Ontario: In 2000 Ontario's total electricity consumption was 503.93 PJ and its population was 11,669,340. National Energy Board, Canada's Energy Future: Scenarios For Supply And Demand To 2025, (2003), Appendix 2, Tables A2.7 and A3.14.

If Ontario could achieve New York's level of electricity efficiency by 2020, our electricity consumption would be 27% less than it is in 2005 despite a projected 18% increase in our population.[57] As a consequence, under this scenario, Ontario will only need 6,688 MW (1,115 MW per year) of new supply between 2015 and 2020 to replace the nuclear generation capacity that will be going out of service.[58]

The new capacity could be obtained from some or all of the following options.

1. Additional Ontario wind, water, solar and biomass projects developed by energy co-operatives, municipal utilities and investor-owned power companies.
2. Purchasing 1,500 MW of water and wind power from Manitoba Hydro. This option would require additional transmission capacity between the Conawapa Generating Station in northern Manitoba and Ontario. As Figure 3 indicates, three transmission options are under consideration, namely:
   a. The Direct Option: a new high-voltage direct current transmission line from Conawapa to Sudbury;
   b. The Thunder Bay Option: a new high-voltage direct current transmission line from Conawapa to Thunder Bay and an alternating current transmission line from Thunder Bay to Sudbury; and
   c. The Winnipeg Option: a high-voltage direct current transmission line from Conawapa to Winnipeg and alternating current transmission lines from Winnipeg to Thunder Bay and Sudbury.

Fig. 3
Manitoba - Ontario transmission options



Source: Preliminary Assessment of the Potential for a Clean Energy Transfer Between Manitoba and Ontario, September 2004

The Winnipeg Option is the ecologically preferred route since it would not bisect Ontario's intact northern boreal forest. The Winnipeg Option's bi-directional capability would also provide increased system reliability for Manitoba since it would allow Ontario to provide supply required by Manitoba Hydro in the event of an emergency. In addition, this option would allow Ontario to sell Manitoba excess power at off-peak hours, allowing Manitoba to store water temporarily, to be released later in order to generate power for Ontario during peak times.[59] This has the advantage of reducing the need to increase costly peaking generating capacity in Ontario.

3. Additional renewable power purchases from Manitoba. According to Manitoba, it has approximately 3,500 MW of additional potential renewable supplies above and beyond the 1,500 MW Conawapa project.[60]
4. New natural gas-fired combined heat and power (co-generation) projects.

The Pembina Report – Ontario can replace both coal and nuclear

In 2004 the Pembina Institute for Appropriate Development issued its report: Power for the Future: Towards a Sustainable Electricity System for Ontario. This report analyses the potential to meet Ontario's electricity service needs in 2020 with a combination of energy conservation, renewable sources and natural gas-fired power plants.

The report's findings on the potential to reduce the demand for electricity are virtually identical to our New York State scenario (i.e., achieve New York State's 2000 level of per capita electricity consumption by 2020). Specifically, according to the Pembina report, Ontario's annual demand for grid-supplied electricity would be 104 billion kWh in 2020;[61] whereas according to our New York State scenario, Ontario's annual end-use electricity consumption would be 103 billion kWh in 2020.[62]

According to the Pembina report, capital investments of $18.2 billion between 2005 and 2020 "would be required to achieve these savings through energy efficiency, fuel-switching and cogeneration. However, 96% of these costs would be recovered by consumers through their savings in energy consumption resulting from these investments."[63] This would leave a net expenditure of $728 million, less than the cost of a single Pickering reactor restart.

The report further states that Ontario's need for 104 billion kWh of grid-supplied electricity in 2020 could be met

exclusively through a combination of existing water power, existing natural gas-fired power plants (including oil-fired power plants converted to natural gas), wind power, new water power, biomass and high-efficiency natural gas-fired power plants. The break-out of our potential electricity generation mix in 2020 is shown in Table 3.

Table 3:

Pembina Institute's Final Estimated Grid Demand and Supply Mix in 2020[64]

	Billion kWh	Percent
Existing Water Power	33.572	32%
Existing Peaking Gas and Replaced Oil	12.208	12%
Wind	18.396	18%
New Water Power	8.760	8%
Biomass	5.606	5%
New Natural Gas-Fired Combined-Cycle Power Plants	25.623	25%
Total	**104.165**	**100%**

Note: The Pembina report's analysis of Ontario's new water-power potential did not take into account the potential for water-power imports from Manitoba or Quebec.

Impact on North American Natural Gas Demand

If Ontario were to replace all of its coal and nuclear plants exclusively with high-efficiency combined-cycle natural gas-fired power plants by 2020, North American natural gas consumption would rise by 2.5%.[65]

However, if the coal and nuclear power plants are replaced by natural gas combined heat and power (cogeneration) plants, the increase in natural gas consumption would be reduced by 30% or more.[66] As a consequence, under this scenario, the increase in North American gas consumption as a result of replacing all of our coal and nuclear generation with natural gas would be only 1.75%.[i]

If, however, Ontario's 18,446 MW of coal and nuclear capacity are phased-out using a combination of one-third energy conservation, one-third renewables and one-third natural gas-fired combined heat and power, North American natural gas consumption would rise by only 6/10ths of 1%. See Appendix A for more details.

[i] According to a report prepared for the Ontario Ministry of Energy, Ontario's total combined heat and power potential by 2020 is 16,514 MW. Ontario's total existing coal and nuclear generation capacity is 18,446 MW. Hagler Bailly Canada, Potential for Cogeneration in Ontario: Final Report, (August 2000), p. 25; and Independent Electricity Market Operator, 18-Month Outlook, (December 22, 2004), p. 5.

Grade

The significant progress made by the government over the past 15 months means that the essential building blocks for a smooth coal phase-out are now largely in place:

- incentives for local utilities and Hydro One to act as conservation agents and more realistic energy prices to increase interest in conservation measures
- securing of new renewable energy supplies
- securing of new clean energy supplies
- the creation of a coordinating body – the Ontario Power Authority -- to establish a long-term planning horizon and market security for both supply and conservation initiatives in the Ontario electricity market.

The government is now in an excellent position to close the remaining gap between new supply and conservation and current coal-fired generating capacity by increasing its uptake of both renewable power and clean energy supplies. A key area for emphasis here should be demand shifting in order to cut the peak-day capacity gap that still needs to be addressed.

As well, the government should act quickly to exempt self-generation projects – both renewable and natural gas combined heat and power – from the nuclear debt retirement charge. In addition, standard offer prices should be established for small-scale renewable and natural gas combined heat and power projects.

The government's approval of the Beck Tunnel and its interest in rolling out a smart meter program will also be very useful initiatives in the medium term. In the longer term, the government is also essentially in the process of building a foundation for replacing Ontario's aging nuclear capacity, which will require a very similar mix of initiatives.

In most respects, the government's activities of the past 15 months deserve an A+ grade. However, the government made one major misstep in this period by approving the restart of the Pickering A Unit 1 reactor. This dubious investment could prove very costly for Ontario if, as the Minister has acknowledged, continued reliability problems with nuclear units leads to a post-2007 temporary restart of the huge Nanticoke coal fired generating station. For this reason, we are reducing the government's grade to an A.

Appendix A:
Availability of Natural Gas

The National Energy Board has estimated that Canada's remaining gas supplies are 68 to 76 times greater than Canada's total gas production in 2001.[1]

According to the U.S. Geological Survey, the United States' remaining gas supplies are approximately 54 times greater than its total annual gas production. Moreover, the Survey estimates that the world's remaining gas supplies are more than 150 times greater than the current annual global gas production.[2]

This means that North America will likely be increasingly reliant on offshore gas imports in the form of Liquefied Natural Gas (LNG) in the future. Assuming an expansion of LNG infrastructure, this in turn means that, in the long run, North American gas prices will be capped at the cost of importing LNG — namely, $3.80 to $4.82 per Mcf (2000 U.S.$).[3] According to an April 2004 speech by Alan Greenspan, the Chairman of the U.S. Federal Reserve Board:

> "As the technology of LNG liquefaction and shipping has improved and as safety considerations have lessened, a major expansion of U.S. import capability appears to be under way. These movements bode well for widespread natural gas availability in North America in the next decade and beyond."[4]

Currently, there are three proposals to build LNG facilities in Canada: Anadarko Petroleum Corporation is building a LNG terminal at Bear Head, Nova Scotia. [5]; Irving Oil has received regulatory approval to build a LNG terminal in Saint John, New Brunswick; [6] and Enbridge Inc., Gaz-Metro and Gaz de France are proposing to build one near Quebec City.[7]

Natural gas is a finite fossil fuel source and should only be seen as a transition fuel that can be used until such time as a combination of renewable sources, conservation and new technologies (e.g. hydrogen fuel cells), is capable of meeting our energy needs. As all fossil fuel supplies decline over the next century, the attractiveness of technologies like wind, solar and hydro will dramatically increase as will interest in conservation and energy efficiency. According to energy expert Amory Lovins, energy efficiency can "reduce by at least severalfold the quantity of electricity needed to provide present services with unchanged or improved quality."[8] But it is also clear that natural gas supplies are sufficient to allow for a lengthy and controlled transition period without any dramatic energy price increases in the short to medium term.

Appendix B:
Air Pollution and Ontario Power Generation's Coal-Fired Power Plants

In 1998 the Ontario Medical Association (OMA) announced that air pollution is "a public health crisis" in Ontario.[1]

According to the OMA's report, The Illness Costs of Air Pollution in Ontario, air pollution costs Ontario more than $10 billion per year in health care costs, lost work time and other quantifiable expenses, as well as killing over 2,000 Ontarians each year.[2]

In 2001, the OMA released a report that indicated that ozone levels are continuing to rise in Ontario. According to the OMA, the "overall increasing trend in the annual average ozone levels in Ontario will continue to cause serious health damage for the people of Ontario."[3]

The five coal-fired power plants run by Ontario Power Generation (OPG, formerly Ontario Hydro) are major contributors to the public-health crisis caused by air pollution in Ontario:

1. OPG's coal plants produce as much air pollution as 6.2 million cars.[4]
2. OPG's coal plants are responsible for 67% of Ontario's chromium emissions (a carcinogen)[5]; 39% of Ontario's airborne mercury emissions (a neurotoxin)[6]; 27% of Ontario's sulphur dioxide emissions (smog and acid rain)[7]; 27% of Ontario's arsenic emissions (a carcinogen)[8]; approximately 20% of Ontario's greenhouse gas emissions (global warming and climate change)[9]; and 14% of Ontario's nitrogen oxides emissions (smog and acid rain)[10].
3. OPG's Nanticoke coal-fired power plant on Lake Erie is Canada's #1 air polluter. Nanticoke produces more air pollution than is reported by all the polluters in Saskatchewan, Manitoba, New Brunswick or Nova Scotia.[11]
4. OPG's Lambton coal-fired power plant near Sarnia is Ontario's #2 air polluter.[12]
5. OPG's coal plants also emit dioxins and furans (endocrine disruptors) and lead (a neurotoxin).[13]
6. The output and greenhouse gas emissions of OPG's coal-fired power plants increased by over 120% between 1995 and 2003. [14]

By converting from coal to high-efficiency natural gas, these emissions can be dramatically reduced. Specifically, switching from dirty coal to cleaner burning natural gas for electricity generation will reduce greenhouse gas emissions by 61%; nitrogen oxides emissions by more than 90%; sulphur dioxide emissions by 99.5%; and mercury, lead, dioxin and furan and cancer-causing emissions by 100%.

Endnotes

[1] According to preliminary estimates Ontario's coal-fired generation in 2004 was approximately 28 billion kWh. Email from Rick Jennings, Director, Energy Supply and Competition Branch, Ontario Ministry of Energy to Jack Gibbons, Ontario Clean Air Alliance, January 7, 2005; and Ontario Power Generation, Towards Sustainable Development: 2003 Progress Report, p. 30.

[2] Email from Rick Jennings, Director, Energy Supply and Competition Branch, Ontario Ministry of Energy to Jack Gibbons, Ontario Clean Air Alliance, January 7, 2005; and Ontario Power Generation, Towards Sustainable Development: 2003 Progress Report, p. 30.

[3] Independent Electricity Market Operator, 18-Month Outlook: An Assessment of the Reliability of the Ontario Electricity System, (December 22, 2004), p. iii.

[3b] Legislative Assembly of Ontario, Official Report of Debates (Hansard), December 1, 2004, p. 4612-4613.

[3c] Legislative Assembly of Ontario, Official Report of Debates (Hansard), December 13, 2004, p. 4888.

[3d] Legislative Assembly of Ontario, Official Report of Debates (Hansard), December 14, 2004, p. 4936.

[4] Tom Spears, "Coal plants will shut, but stay as backups: Ontario may need to bring coal-fired generators back online after promised 2007 closings", Ottawa Citizen, November 30, 2004.

[5] Peter Fraser, International Energy Agency, Nuclear Power and Electricity Markets in the OECD, Presentation to the OPG Review Committee, February 17, 2004.

[6] In 2003 Bruce Power and OPG produced 24,500 and 37,700 GWh of nuclear power respectively. Their total nuclear capacity was 13,864 MW. Bruce Power, News Release, "Bruce Power partners announce 2003 results", (January 27, 2004); Ontario Power Generation, Towards Sustainable Development: 2000 Progress Report, p. 55 and Towards Sustainable Development: 2003 Progress Report, p. 32. Government of Ontario, Direction for Change, (1997), p.5.

[7] The August 2003 blackout began on August 14th at 4:11 p.m. Power was totally restored to all New York customers by August 15th at 10:45 p.m. Ontario's power emergency did not end until 8 p.m. on August 22nd. New York Independent System Operator, Fulfilling Our Mission: 2003 Annual Report, p. 3; Independent Electricity Market Operator, Participant News, "IMO Says Ontario Residents Deserve Special Thanks", (August 22, 2003); URL: http://www.theimo.com/imoweb/news/newsItem.asp?newsItemID=756, Retrieved January 4, 2005; and Ontario Ministry of Energy, August 14 2003 Outage Report; URL: http://www.energy.gov.on.ca/index.cfm?fuseaction=electricity.reports_outage; Retrieved December 21, 2004.

[8] OPG's coal-fired electricity generation was 16,699 and 36,255 gigawatt-hours in 1995 and 2003 respectively. Email from Bob Kozopas, Ontario Power Generation to Jack Gibbons, Ontario Clean Air Alliance, August 22, 2000; and Ontario Power Generation, Towards Sustainable Development: 2003 Progress Report, p. 30.

[9] Ontario Ministry of Energy, News Backgrounder, "Ontario Energy Board Amendment Act Highlights Of The Proposed Changes", (November 25, 2003); and Legislative Asssembly of Ontario, Official Report of Debates (Hansard), Tuesday 9 December 2003, Standing Committee on Justice and Social Policy, page J-6.

[10] On average between 1999 and 2001 Enbridge's conservation programs had a ratio of net bill reductions per dollar of utility spending of 7 to 1. Ontario Energy Board Docket No. RP-2003-0203, Ex. L, Tab 11, Sch. 1, p. 2.

[11] Notes For Remarks By The Honourable Dwight Duncan, "Choosing What Works For A Change", The Empire Club, April 15, 2004.

[12] Ontario Energy Board Docket No. RP-2004-0203, December 7, 2004 Transcript Volume, paragraphs 20 to 29.

[13] The Beck Tunnel will incease the output of the Sir Adam Beck Generating Station by 1,600 gigawatt-hours per year. In 2003 the Lakeview Generating Station produced 2,806 gigawatt-hours of electricity. Ontario Ministry of Energy, News Release, "McGuinty Government Gives Green Light to Expand Electricity Generation at Niagara Falls", (June 25, 2004); and Ontario Power Generation, Towards Sustainable Development: 2003 Progress Report, p. 30.

[14] Assuming a capital cost of $600 million, an economic life of at least 50 years and an 8% real cost of capital.

[15] Ontario Power Generation, News from Ontario Power Generation, "Ontario Power Generation Invites Pre-Qualified Companies To Submit Design-Build Proposals For Niagara Tunnel Project", ((December 20, 2004).

[16] Ontario Ministry of Energy, News Release, "McGuinty Government Gives Green Light to Renewable Energy Projects", (November 24, 2004).

[17] The annual output of these projects is 1,200 gigawatt-hours. In 2003 the Lakeview Generating Station produced 2,806 gigawatt-hours of electricity. Ontario Ministry of Energy, Results of the 300 MW Renewables RFP, Media Pre-Briefing, November 24, 2004, Slide #11; and Ontario Power Generation, Towards Sustainable Development: 2003 Progress Report, p. 30.

[18] The average weighted electricity cost of the projects is just under 8 cents per kWh including the cost of connection to the transmission or distribution grid. Ontario Ministry of Energy, Results of the 300 MW Renewables RFP, Media Pre-Briefing, Slide #9.

[19] Ontario Hydro Final Annual Report: January 1998 – March 1999, p. 67. After March 1999 approximately $20 billion of nuclear debt was shifted from Ontario Hydro to the Ontario Electricity Financial Corporation.

[20] Ontario Clean Air Alliance, Manley's Spreadsheet Revisited: Natural Gas vs. Nuclear Power, (May 25, 2004).

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[54] Independent Electricity Market Operator, 10-Year Outlook: An Assessment of the Adequacy of Generation and Transmission Facilities to Meet Future Electricity Needs in Ontario, (April 29, 2004), p. 7; and Ontario Power Generation, Towards Sustainable Development: 2000 Progress Report, p. 55.

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[57] In 2020 Ontario's population is forecast to be 13,811,090. If in 2020 our per capita end-use electricity consumption equaled that of New York State in 2000, our total end-use electricity consumption would be 103,127,409,000 kWh (13,811,090 x 7467 kWh per capita). Assuming transmission and distribution line losses of 10%, this entails the need for 113,440,150,000 kWh of electricity generation. Ontario's electricity generation in 2005 is forecast to be 154,400,000,000 kWh. National Energy Board, Canada's Energy Future: Scenarios For Supply And Demand To 2025, (2003), Appendix 2, Tables A2.7 and A3.14; Ontario Energy Board, 2002-03 Annual Report, p. 20; and Independent Electricity Market Operator, 18-Month Outlook: An Assessment of the Reliability Of the Ontario Electricity System, (December 22, 2004), p. iv.

[58] According to the Independent Electricity Market Operator (IMO), Ontario's peak day required resource in 2005 is 27,375 MW. If Ontario's peak day demand is reduced by 27% by 2020, Ontario's peak day required resources will be 19,984 MW. Furthermore, according to the IMO, Ontario's total existing generation resources in 2014 will be 22,325 MW. The retirement of the 9,029 MW of remaing nuclear capacity between 2015 and 2020 will reduce Ontario's existing generation in 2020 to 13,296 MW. If Ontario's peak day requirements in 2020 is 19,984 MW then 6,688 MW of new generation (19,984 MW – 13,296 MW) will be needed between 2015 and 2020. IMO, 18-Month Outlook, (December 22, 2004), p. 23; and IMO, 10-Year Outlook, (April 29, 2004), p. 7.

[59] Ontario Ministry of Energy, News Release, "Ontario and Manitoba Take Next Steps on Joint Energy Project", (September 30, 2004); and Manitoba/Ontario Study Team, Preliminary Assessment Of The Potential For A Clean Energy Transfer Between Manitoba and Ontario, (September 2004), pp. 23 – 25.

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[62] In 2020 Ontario's population is forecast to be 13,811,090. If in 2020 our per capita end-use electricity consumption equaled that of New York State in 2000, our total end-use electricity consumption would be 103,127,409,000 kWh (13,811,090 x 7467 kWh per capita).

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Ontario Clean Air Alliance Members

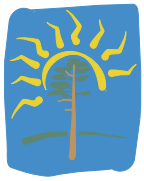
MUNICIPALITIES
Guelph
Hamilton
Kitchener
Markham
Peterborough
Regional Municipality of Durham
Regional Municipality of Peel
Regional Municipality of Waterloo
Stratford
Toronto
Windsor

COMPANIES
AIM PowerGen Corporation
Breathe Smog Masks Inc.
Enwave District Energy Limited
Hydro 2000
Indigo Wind Energy Systems
Mississippi River Power Corporation
Oshawa Power and Utilities Corporation
Peterborough Utilities Services
Selectpower
Sudbury Hydro
Toronto Hydro
Torrie Smith Associates
Veridian Corporation
Vertebrae Technologies Inc
Wellington Electric Distribution Company
Whitby Hydro Energy Services Corp.

ORGANIZATIONS AND ASSOCIATIONS
Algoma Manitoulin Environmental Awareness
Algoma Manitoulin Nuclear Awareness
Allergy/Asthma Information Association
Association of Local Public Health Agencies
Canadian Association of Physicians for the Environment
Canadian Institute for Environmental Law and Policy
Canadian Institute of Child Health
Cashmere Avenue PS EnviroClub
CAW Canada*
CAW Durham Regional Environment Council
CAW Windsor Regional Environment Council
Canadian Unitarians For Social Justice, South Peel Chapter
Citizens Advisory Committee on Air Quality - Waterloo
Citizens Advocating Renewable Energy
Citizens Environmental Alliance of Southwestern Ontario**
Citizens For Renewable Energy
Citizens Network on Waste Management
Community Action Parkdale East
Community Environmental Alliance
Conservation Council of Ontario
Conserver Society of Hamilton and District, Hamilton Chapter
Consumers Association of Canada (Ontario)
EarthDay Canada
Earth Works
Echo Lake Association
Eneract
Energy Probe
Evergreen Foundation
Environmental Defence Canada
Environment North
Federation of Ontario Cottagers' Associations
For A Safe Environment
GASP
Green Channel
Greenest City
Hearthmakers Energy Cooperative
Kingston Environmental Action Project
Lakeshore Area Multi-Services Project Inc.
Learning Disabilities Association of Ontario
North Toronto Green Community
Ontario College of Family Physicians
Ontario English Catholic Teachers' Association
Ontario Forestry Association
Ontario Lung Association
Ontario Public Health Association
Ontario Public Interest Research Group McMaster University
Ontario Public Interest Research Group Guelph University
Ontario Public Interest Research Group University of Toronto
Ontario Public Interest Research Group Queen's University
Ontario Society for Environmental Education
Peel Environment Network
Pesticide Action Group/Waterloo
Pollution Probe
South Riverdale Community Health Centre
Thames Region Ecological Association
The United Church of Canada
The Unitarian Fellowship of Sarnia-Port Huron
Wastewise
Wildlands League
World Wildlife Fund

*CAW Canada is opposed to the privatization of Hydro One and Ontario Power Generation

**Citizen's Environmental Alliance of Southwestern Ontario and EnerACT support a full phase-out of nuclear energy.



Ontario Clean Air Alliance
625 Church Street, Suite 402
Toronto M4Y 2G1

Tel: (416) 926-1907 ext. 245
Fax: (416) 926-1601

E-mail: info@cleanairalliance.org
Web Site: www.cleanairalliance.org

ONEIA

Chair
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Advocacy Vice-Chair
Harry Dahme
Gowling Lafleur Henderson LLP

Business Development Vice-Chair
Michael Brandt
Montego Group

Ontario Environment Industry Association (ONEIA)
4850 Keele St., 2nd Floor
Toronto, Ontario
M3J 3K1

Manager of Membership Services and Program Development
Shai Spetgang

Tel: (416) 531-7884
Email: info@oneia.ca
Web: www.oneia.ca

Submission by the
Ontario Environmental Industry Association
(ONEIA)

to the
Ontario Power Authority

on the

FUTURE SUPPLY MIX FOR ONTARIO

August 25, 2005

The Ontario Environmental Industry Association (ONEIA) welcomes the opportunity to respond to the OPA's call for written submissions on the energy supply mix for Ontario.

Established in 1991, ONEIA represents the interests of the environmental and energy technology and services industry in Ontario. ONEIA members include businesses offering energy conservation technologies and services as well as renewable and alternative energy generation technologies. Ontario's environmental and energy technology and services companies are well recognized both nationally and internationally for their innovative and creative solutions to energy problems.

ONEIA strongly recommends that the energy supply mix should include an aggressive emphasis on energy conservation programs and alternative and renewable energy generation. We suggest a clearly defined process that allows Ontario based companies to compete for energy based installation projects. Because of the complexity of the issue and the number of directions solutions must come from, initiatives to reach each of the very different goals need to be broken down into manageable and implementable programs, clearly communicated to suppliers and consumers (residential, commercial and industrial), with measurable targets to evaluate success.

In addition, the Ministry of Energy and the Ontario government as a whole must take a leadership role in identifying and removing barriers to the use of energy conservation and to new renewable technologies and distributed generation. This is especially true for conservation, renewable and alternative forms of energy that tend to be smaller projects with numerous barriers to installation.

OPA has requested advice on four "issue areas".

1. **Appropriate analytical planning approaches for assessment of risks**

    - ONEIA and its members have strong expertise in the technical aspects of energy and the environment. This technical understanding also drives knowledgeable policy development including climate change and how to achieve energy policy. In terms of "the assessment of risk that could affect portfolio performance", ONEIA can contribute significantly in the areas of environmental assessment and the technical assessment of equipment including operability issues as well as emission profiles and/or controls. These "approaches" already exist through the Environmental Assessment process and the Certificate of Approval process administered by the Ministry of Environment.

- In addition to the technical risks and environmental consequences, the supply mix should include a multi-attribute assessment to capture the significantly different socio-economic and sustainable development issues inherent in the supply versus demand management options. ONEIA would welcome the opportunity, at a later date, to discuss the various approaches to risk assessment for an integrated resources planning methodology.

2. Appropriate approaches to constructing Conservation Demand Management

- Again the request appears to want specific and detailed approaches including costs, achievable conservation potential, and sector specific characteristics and approaches. ONEIA members have significant knowledge in these areas but it is more appropriate to discuss the barriers that exist to implementation.

- ONEIA believes that the private sector can deliver tailored conservation and demand management projects within a carefully developed program administered by the Ministry of Energy and/or OPA that removes the barriers that restrict good economic business energy conservation opportunities.

- Implementation of CDM is an everyday challenge, especially with SME's in Ontario. It is difficult to encourage high value conservation projects especially with the limited resources companies appear to have to dedicate to this area. Programs that help in the diagnosis and implementation of energy saving projects would help achieve better results in overall installation of projects. Consideration should be given to programs directed to investigation and implementation. This can include funded investigations, creative financial incentives for implementation (ie. tax incentives), and/or educational forums.

- Education and awareness program initiatives to make industry and commercial entities move toward implementation must be improved. The promotion of Demand Management Programs should harmonize the Ontario Energy Board's CDM mandate with the federal government's Climate Change energy efficiency efforts. The two levels of government have a Memorandum of Understanding on Climate Change and

harmonization will be as beneficial in this area as it is in other areas of joint responsibility such as health, education, and taxation.

- ONEIA would be please to work with OPA to provide more insight and discussion on the barriers to implementation and program delivery.

3. Assessments of different supply technologies in the Ontario setting

- As ONEIA represents many alternative and renewable technologies from geothermal, to wind, to solar, and biomass, it is useful to review the barriers to implementation for these technologies.

- Based on the large investment requirements to establish new generation capacity, including alternative and renewable, the market attracts investment from outside of the province. It is difficult for Ontario technology firms to participate in this marketplace. Initiatives and/or programs that help buffer this initial upfront investment are suggested.

- The economics of many clean and renewable energy generation options such as wind, geothermal, biomass etc. does not effectively compete with the economics of gas fired or other more conventional power generation since the current costing methodology may not capture the complete lifecycle costs. ONEIA suggests incentive programs, such as tax incentives, technology demonstration grants, and the recently recommended feed-in tariff, that can help define and improve the economics of clean and renewable energy and make new products more attractive as an investment.

- Consider more promotion and possible incentive to invest in small-distributed energy systems. These systems can reduce transmission and distribution losses and improve security of supply, especially to local communities and/or industries. While these investments should still meet good financial investment criteria their contribution to sustainable development should also be recognized.

- ONEIA also advocates the use of Energy from Waste (EFW) and believes this form of energy generation should be considered as part of the supply mix because it addresses both a waste diversion problem and provides an alternative fuel for energy generation.

4. Assessment of Environmental Impacts

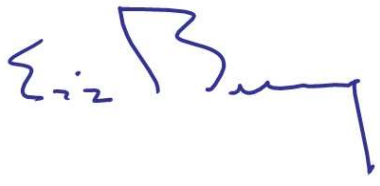
- ONEIA's input to this issue is similar to the first issue above. Methodology for assessing the environmental impacts already exists through the environmental assessment process and the Certificate of Approval process administered by the Ministry of the Environment. ONEIA members have significant experience in the implementation of a number of environmental screening tools.

- Some of the improvements that can be made include simplification of the environmental screening process (for example, the Environmental Assessment process is too long).

ONEIA has presented a number of barriers to the implementation of Energy Policy, especially as it relates to conservation and alternative and renewable sources of power for the overall supply mix. While the total amount of potential generation capacity may not be large in terms of overall provincial needs, it represents the most sustainable aspects of Energy Policy and aggressive action and targets for conservation and renewables could significantly increase their contribution to the energy mix. It is also the most complex part of the supply mix and the most difficult to deliver.

With the heightened interest in newly designed Green Buildings and major advances in Building Automation Technology that can reduce energy usage and the environmental consequences, there is a need for a new approach to energy planning that is sustainable and socially responsible.

Finally, ONEIA is in a unique position to provide input, through its members and by activities such as the organization of directed workshops to obtain and provide more detailed guidance.



Eric Barry
Co-Chair – Energy Subcommittee

Mark Vanderheyden
Chair - ONEIA

Ontario Federation of Agriculture

40 Eglinton Avenue East, 5th Floor, Toronto, Ontario M4P 3A2
(416) 485-3333 Fax: (416) 485-9027 Web address: www.ofa.on.ca

August 26, 2005

Ontario Power Authority
Supply Mix Submissions
175 Bloor St. East, North Tower, Suite 606
Toronto, Ontario
M4W 3R8

Gentlemen:

The Ontario Federation of Agriculture is pleased for the opportunity to submit the attached notes for your consideration.

The OFA's concerns do not focus on the amount of generation of wind or thermal or nuclear that should be built in any particular year. Rather, the OFA is concerned with improvement in the circumstances for supplying power, so that the desirable generating capacity of each kind of power gets built. To this end the OFA offers suggestions that will encourage new power development and, in particular, a mechanism to ensure replacement cost pricing whereby the premium entailed in such pricing is used in Ontario to provide Ontario with the power.

The OFA feels that the timing of various measures should be a priority for the OPA. More specifically, it is crucial to enable projects now that can be accomplished in the next four to five years. And it is crucial to start the planning now for those things such as nuclear plants or large thermal plants, which require a decision in the next three to six years so that construction, if warranted, can begin five to ten years down the road. The OFA suggestions focus heavily on initiating the smaller projects, which have long been ignored in Ontario.

The OFA looks forward to seeing the OPA work with Ontario residents in an open and forthright way on the future of the power supply and sees your request for submissions as a good start. Distribution of all submissions to this process to all other participants might facilitate a more productive discussion. The OFA would be pleased to meet with OPA to discuss ways of achieving a renewed state of modest surplus capacity.

Please accept our best wishes for success in all your work.

Sincerely,

Neil Currie
General Manager

Notes from the Ontario Federation of Agriculture
Concerning Ontario's Power Mix

1 Who we are and why farmers are concerned about hydro

The Ontario Federation of Agriculture is Canada's largest volunteer membership farm organization. OFA speaks for Ontario's farmers on matters that are general to all farm commodities. Electricity is an essential farm input. Without reasonably priced power the production and processing of food in Ontario would be uncompetitive and likely extinct. Agriculture is Ontario's second largest industry. Reliable and reasonably priced power is essential to its sustainability.

Farming has had the highest increase in total factor productivity of any sector in Canada, decade after decade. More food is produced on less land, with less fuel, less chemicals and less manpower now than in the past. A great deal of that success is attributable to the development and adoption of new technologies, many relying on electricity. The continued success of farming depends, in part of the future of the hydro supply. Ontario's farmers are determined to either see the provision of hydro improve through commercial or private supply.

2 Today's power supply

Ontario is estimated to have about 33 GW of total capacity of which approximately 26 'works'. And of the 26 GW, at any one time about 3 to 6 GW are offline for maintenance. And of this 21 to 24 GW about 80% is fully available. The other 20% is not there because water levels are low, or a plant is using a lower grade of coal and getting less heat than it was designed for or because reactor tubes now function below design capacity. In round numbers, Ontario has 20 GW of reliable capacity and, if every thing goes well, it can muster about 23 GW. But this capacity is declining as new planned sources do not yet exceed the effects of aging. New planned sources do not counter the effects of going off coal.

Ontario has gone from an envisioned and technically managed state of over supply to being on the cusp of repeated shortages that owes to a lack of planning and execution.

3 A new vision and its price

Ontario must return to a state of modest surplus of supply. In a purely private model, this would create a commodity situation similar to farming, where there is low cost food for all, but only meager livings for farmers. And it would discourage new entrants. A better state of affairs is possible and this can be achieved by addressing the power price. The price must provide what all retail prices provide - sufficient revenue to enable replacement so there is power for today and tomorrow.

Hydro in Ontario has been priced at cost for 100 years. This worked by accident as the replacement cost declined over most of that hundred years. Now the replacement cost has risen so the price must rise or Ontario will go short. Yet Ontario residents rightly fear that if they pay replacement cost for power, companies will take the premium and build power plants in Ohio and import power at still higher prices, or the premium revenue might simply be held as profit. There is no mechanism to ensure reinvestment in Ontario's power system.

This missing mechanism can be easily supplied. In agriculture when something important is missing in a market, such as funds for research or commodity promotion; farmers create a 'check-off' fund, whereby a small fraction of the revenue is deducted from each farmer and pooled to be used for research or marketing etc.

The Ontario Federation of Agriculture has long requested that Ontario create **a check-off fund** for power. The fund might add as much as two cents to the cost of power. One third of a cent extra might be used to pay down the old hydro debt. Half a cent might be used for conservation and a full cent used to create a 'bank' where power developers could apply for funding to build power in Ontario. The OPA is the logical home for this 'bank'. Developers could still use private funds, but the check-off funds administered by the OPA would ensure that power supply was built in Ontario. New generation would get sufficient return to want to build in Ontario and mature generation would get market returns in a competitive environment.

The funding would be extended based on which firms from among the technically able would provide the most power for the best price. A mechanism of this sort would ensure that the premium needed to have replacement cost power would be used to ensure the supply of replacement power. Without pricing based on replacement cost, Ontario will always have to wonder about its next kwh. And when farms and business have that concern they will invest elsewhere. The farmers' vision is to make things grow – also a suitable vision for hydro in Ontario.

4 Needed actions and their prices

4.1 Going off coal

The first emerging threat to Ontario's supply capacity is the political decision to go off coal. The Ontario Federation of Agriculture approves the intent of eliminating coal, but believes that the timing and finances must be more effectively timed.

The general assumption has been that Ontario can go off coal by building gas pipelines to coal stations and converting the boilers to gas fired units, similar to the conversion of Lennox and Addington from oil to gas. This is technically possible. However, it takes time and it requires that there be long term (30 year) gas contracts that allow the plants to operate as base load plants. At present prices expensive coal produces heat at $2.00 a gigajoule. Low cost gas costs over four times that and gas at current prices suggests a breakeven price of over 11 cents per kWh for such power without including the costs of retrofitting the coal plants, compared to about 5.5 cents per kWh for power from fully scrubbed clean coal.

Ontario can have cleaner coal plants at a cost of about 1.5 cents per kWh more or coal plants converted to gas at a cost of 6.5 cents per kWh more. This does not account for the increased gas costs for millions of homes and businesses as well as in fertilizer and chemical costs increases for farmers. The cost of going off coal at present prices would also include increased unemployment, lost investment and lost production. Until the present coal plants reach a more advanced stage in their operating life, and until Ontario produces substitute supplies with suitable transmission connections, OFA advocates using premium grades of cleaner coal, fully scrubbed so Ontario has power at a cost that we can afford with improved air quality.

The full coal replacement program must be phased to dampen these significant negative impacts.

4.2 Making better use of what we've got –

Three ways of making better use of what we've got includes: conservation, buying-in latent capacity and load shifting. OFA does not believe that curtailing economic production by buying consumers out of the market is a sensible initial option. At best it is a last resort. However, it may make sense to curtail luxury consumption by conservation measures, which target such consumption.

4.2.1 Conservation

Shoulder period conservation saves some costs for the consumer and it may reduce some air pollution, but it does not defer or eliminate the need for new generation or transmission lines. Conservation must address peak periods if it is to play a role in generation. A kWh saved in a shoulder period is worth a nickel, a kWh saved at peak is worth 25 cents plus the cost of building a kW of generation capacity. Additionally, the positive pollution reduction benefits are greater from targeting peaks. OFA's advice with respect to conservation efforts is to target the peaks aggressively.

To effectively free up generating capacity conservation must reduce both winter and summer peaks. Winter peaks are driven by heating and lighting. Summer peaks are driven by air conditioning.

Electric heat needs can be reduced by insulation and, to a modest extent, by heat and power storage. Insulation investments in electrically heated public housing should be a priority. Lighting needs can be addressed by the distribution and use of more efficient light bulbs. Every means should be used to assist the distribution and installation of such bulbs including subsidies for efficient bulbs and an extra sales tax on inefficient bulbs.

In the press over the past months there have been articles and letters commenting on the conflict in offices where men in suits require that air conditioners be set at 20 degrees or less while females workers have heaters under their desks. Situations like this are absurd. Leadership is required within the business community and public to avoid such wasteful situations. Building owners and operators must be held accountable to ensure suitable and efficient cooling systems are available to avoid hot and cold zones in buildings.

Central air conditioning contributes 9 GW to Ontario's summer peaks of 25 GW. It is the largest single load. Rewards for year over year reductions in power use in the months of June through September coupled with an increase in residential and office space power costs in those months might compel some saving. OFA supported smaller base tiers for consumers on Regulated Rate Plan and asks that further efforts be made to curb excessive summer air conditioning. It is a luxury use that drives up the cost of power for everyone. It costs jobs and forces us to build billions of dollars of generating capacity that we would not need if office windows opened. The positive thought is that an 11% reduction in air conditioner use would free up 1 GW at peak times.

4.2.2 Harness latent capacity

Latent capacity can be bought in and paid to go online at peak periods. Examples of such capacity include back up generators on farms, emergency generators in hotels, hospitals, computer centres etc. If these generators had suitable meters (and they exist) the owners of the generators could be paid a premium price to go off grid whenever prices were over a threshold or whenever Ontario's spare capacity was under 500,000 Mw. If all these units were to be used to take their owners off grid at critical times, they would free up over a GW of capacity. The owners need a modest annual participation fee and an assured price of about 25

cents a kWh to cover fuel and wear and tear. They would add effective capacity and reduce prices. They would defer the need for peak investment and save all customers from higher costs, thus saving far more than their costs.

4.2.3 Load shifting

Load shifting can be achieved by using power off peak or by storing power in off peak periods and using it later. Doing things off peak happens now. Compared to many other places Ontario's difference between day and night use levels is low. It could be better, but it is presently low. However there is potential for two kinds of night storage.

Nuclear plants could be used at night to pump water uphill into storage lagoons. Night storage is only practiced at Niagara Falls. It was planned for Collingwood and abandoned during a period of high interest rates. The plans could be revived. Any elevated place close to both a transmission line and a large water body would provide a possible location. The Bruce Peninsula, the Ottawa valley, the North Channel of Lake Huron and several conservation area dams offer possible locations. Night storage turns three-cent nighttime power into nine-cent daytime power. It is not free, but a six-cent day to night price differential will pay for it. This form of night storage requires that new peak generators be built. But that is the kind of new generation that Ontario needs most. OFA strongly suggests that Ontario identify sites where night storage based generation would be possible and undertake to have those sites suitably developed. Technically this is new generation, but it is new generation that helps make better use of existing capacity.

Night storage can also be practiced at a smaller scale and without any need for new generation capacity to be built. The electronic and battery components of a residential solar electric system without the solar cells can be used by the owner to buy night time power on a contract, stored and used later. The owner must spend in order to save. But the owners spending saves Ontario from adding to its peak generating capacity and it improves the rate of return on existing base capacity. If100,000 homes were to have such units rated at 20 kW the daytime peak needs might be reduced by a GW. The cost of this capacity is high per kW, but it can be installed very rapidly as there are many firms with the capability. Public support for such installations to the extent of $300 a kW of capacity to some maximum based on past power use would be less costly than building new capacity. And the owners and non-owners would all benefit with reduced daytime peaks and lower prices. OFA believes that this option should be examined and support provided to expedite families and businesses storing nighttime power to meet their peak period needs.

4.2.4 New generation

4.2.4.1 Run of the River

Ontario has made little use of the potential for power from run of the river installations. Normally these generators entrain water over the period of a mile or less where there are rapids. Longer entrainments are possible in areas of stiller water and similar effective heads can be achieved. Such installations should be examined for the St. Clair and Detroit Rivers in particular as developments there would contribute to sustaining the ground water levels that are crucial to farming in SW Ontario. This would be new generation with a substantial environmental benefit.

4.2.4.2 Gas Co-Generation

Ontario has thousands of businesses that use large amounts of gas for heat and which also use power. Ontario should be willing to pay a premium price in order to get the most out of this natural gas. OFA has long advocated a premium price for power that has special benefits.

Gas co-gen (and tri-gen) should be paid the higher of 75 % of the import price plus uplift or 12 cents a kWh. This price would make gas co-gen at green houses and many food-processing plants economically viable. The price would be less than what we are paying for imports.

4.2.4.3 Bio Fuel Generation

Ontario should pay the lesser of 70% of the price paid for imports or 13 cents a kWh. Manure and sewage gas, straw, switch grass all offer some potential. It requires a market and government must help make the market.

4.2.4.4 Wind power

The wind industry is getting started in Ontario. The RPF process is slowly making headway. However, the RPF rules rule out many hundreds of small developers. Possibly with combined capacity that would be half or more of the generation potential of the larger developers. OFA again suggests that government make a market by offering to buy the power from wind units under 1 MW at a price that would be the lesser of 80% of the import price or 10 cents a kwh. (It should be noted that the slightly different price levels provide a higher price floor for some forms of green power, but a lower fraction of the import price according to the development and costs and risks associated with the different forms of power. In all cases OFA suggests that this price rule apply only for the first ten years of the unit's operation after which it would receive IESO market prices or a contract price if it sold bilaterally.)

4.2.4.5 Nuclear

Ontario Power Generation is primarily a nuclear power company in terms of output, recent investments and technical focus. It is also unmanageably large, resulting in lack of time devoted to the non-nuclear problems. It is not clear what are profitable operations and the level to which they are subsidizing unprofitable ones. Therefore OPG should be divided into several firms based on their common technologies and possibly also on their market area. This would create at least one nuclear firm, a primarily coal based firm and several hydraulic based firms. Once this has been done the question of whether or not to add new nuclear units or to expand in other ways could be addressed more clearly. The existing problems and potentials must be separated out so a clearer understanding and focus is possible.

Beyond that, it seems that Ontario might or might not need new nuclear plants in the near future. Various groups including the Canadian Nuclear Association are spending advertising dollars to suggest that nuclear power is, once again, today's answer. But it seems yesterday's nuclear questions still have no good answers. Ontario has not addressed the longer-term aspects of nuclear waste storage and Ontario still has several nuclear power plants that do not work. If new nuclear units are to be built they must be better built and better maintained than the first eight units.

4.3 Base or peak?

Ontario's pressing and achievable need is not for additional base load power, but to reduce peak power needs and to add to peak power capacity. These issues should be addressed first and then the question of new nuclear plants can be considered in a very transparent way.

OFA neither opposes nor supports new nuclear power at this time. OFA supports detailed studies and actions that will resolve the waste storage question and demonstrate that the old plants can be made to run safely. Then it will be time to consider new nuclear units and their alternatives.

5 Timing

Timing is everything.

The key is to start now with conservation targeted on peak periods and to simultaneously build or to put rules in place to encourage the private sector to build and complete as much new generation as possible within four years.

Useful steps and their timing include:

1) Allow net metered units to be credits and used for exports in excess of purchases from LDC's. The present and proposed rules ensure that net metering will always lose money and therefore will only happen at an insignificant level.
2) Create a price regime for wind, bio power and co-generation that provides operators with a floor price that ensures profitability and a premium price linked to the price for imported power. The rule would ensure that this power is always less costly than imported power, but always profitable. With such a rule, this power will be supplied. Without such a rule, the risk remains high and the power will not be supplied until it is too late to keep Ontario's economy vibrant.
3) Defer completion of the off coal program until it is clear that the coal plants have served out their economic life and until Ontario is once again a net exporter. (But do not abandon the drive for cleaner air. Install complete scrubbing units and use cleaner coal and make long term gas purchases when it is possible to get good prices in order that there will be sound preparations.)

These first three steps can occur immediately.

4) Move forward in the short term with support for nighttime storage units in homes and businesses. This may seem costly, but it will buy time faster and more effectively than most other physical options and it will involve citizens in the power problem. More than any other thing, effective resolution requires this involvement.
5) Move forward on a program to pay owners of back up generators to go off grid if their power quality is questionable, or to sell to the grid if they have suitable quality during periods of peak prices.

Steps four and five can have their planning start immediately with the first power saved and delivered from these steps on line in less than a year.

6) Examine and move on larger scale hydraulic night storage units possibly at Collingwood, the Ottawa valley and other places where there are heights of land adjacent to water bodies.
7) Examine and move forward on large-scale run of the river power units.

Steps six and seven should have their planning start immediately. However, it would be four to six years before power would flow from these efforts.

8) Restructure OPG in the very near future, so there are separate firms for hydraulic, coal (and the shift from coal), nuclear and perhaps by market area as well.

A restructured OPG will be better able to deal with its role in Ontario's power supply. When these steps are well underway, it will be time to consider new base load power requirements and whether they should be nuclear and if nuclear, whether they should be French, American,

Russian, British, or Canadian in design. The present rush to build nuclear plants that some firms and people are promoting is not likely going to produce nuclear plants that are any better than the original ones built in Ontario. And if there are to be more nuclear plants, they must be better.

6 What is it all about?

Ontario should not imagine that it can remain a global leader in the auto industry and in agriculture and agri-food while it is reliant on imported power. Other jurisdictions will have little interest in selling power to Ontario if industrial advantages are created by keeping their power at home.

Ontario farming enjoys its best prices selling to the Ontario based food processing sector. If power prices rise too much, that sector will slowly move. Potato chips and tinned soup are all made for less if the power costs less. Ontario farming needs power to farm and to retain its best market.

Every business and every family has benefited from abundant low cost power. The OFA has set out a vision and steps to restore that situation in Ontario. It is a vision and plan that derive from the collective experience of tens of thousands of successful lifetimes in every aspect of the world's most competitive commodity sector.

OFA has set out a series of measures and a rough guide to the timing. Ontario built almost a GW of nuclear capacity a year. We did this with about one half the present population and one quarter the wealth. Providing more capacity now should not be insurmountable, but it will take the same sort of drive that built the nuclear plants and Nanticoke.

Success in generation will have to be harnessed first from many smaller achievements. It is only later in the process that medium and larger projects can be undertaken, though the planning for them can start soon. If the little things are not done and done soon, Ontario will lose critical advantages such as our lead in the auto sector and our dominance in Canadian food processing.

The overall aim must be to harness replacement cost pricing to restore additional capacity to Ontario's supply situation.

OntarioMining

August 24, 2005

Ontario Power Authority
606-175 Bloor St. E
North Tower
Toronto, ON
M4W 3R8

To Whom It May Concern:

Re: Call for Written Submissions on Supply Mix

Thank you for the opportunity to comment as the Ontario Power Authority (OPA) prepares to advise the government on a supply mix for Ontario.

Many of the Ontario Mining Association (OMA) members are also members of the Association of Major Power Consumers (AMPCO) and the Industrial Gas Users Association (IGUA). They have submitted technical submissions to the OPA, and the OMA would support in large measure their recommendations.

This is an issue very important to our member companies. In particular, we are concerned that industry competitiveness is not playing a role in government decision making. The long-term sustainability of mining depends on government policy that encourages rather than discourages growth.

The OMA was established in 1920 to represent the mining industry of the province. OMA members are engaged in exploring, producing and processing mineral resources in an environmentally responsible manner.

The majority of OMA members are operating mines in Northern Ontario and produce, gold, nickel, copper and a variety of other metals and minerals. Several other operations are located in Southern Ontario and are involved in the production of salt, gypsum and other industrial minerals. Therefore, we have an interest in the power supply right across the province.

The mining industry is a vital contributor to Ontario's economy. In 2003 we directly employed 16,546 people and contributed over $3.1 billion in value added to Ontario's economy. While creating new jobs are critical to any economy, sustaining those that are the backbone of our existing standard of living, and the tax base to three levels of government, must also be considered. The IESO's 10-year Outlook published July 2005 recognizes the value of mining by saying much of the strength in the growth of 2004 can be attributed to the resource sectors of the economy.

Ontario has long been a preferential mining jurisdiction due to favorable geology and certainty of operating cost. Unfortunately, our competitive advantage has eroded with the escalating energy prices in comparison to competing jurisdictions. Most companies operating in Ontario have properties throughout the world. The nature of the mining business is that costs cannot be passed along to the consumer, therefore a large spike in energy pricing greatly changes the feasibility of an Ontario operation.

In 2003, The Ontario mining industry's electricity bill totaled an estimated $256 million or 67% of total energy spending by the industry. The remaining $127 million was spent predominantly on natural gas. The price for electric power has increased by almost 30% in 2002 and a further 10% in 2003. This at a time other input costs like labour and inflation are at 2%.

In the face of rising energy prices, the mining industry has been at the forefront of implementing energy efficiency initiatives. Measures to reduce energy consumption have included natural gas reduction initiatives through gas control and burner elimination, energy efficiency initiatives including the upgrading and retrofitting of plant equipment and utilization improvement. These programs have not only saved million of dollars, but have also had positive environmental impacts.

As stated in the IESO's 10 year Outlook, the phase-out of coal by 2009 represents the largest and most significant electricity system change ever undertaken in Ontario. It involves major technical consideration and significant risks and challenges that need to be addressed. We therefore feel strongly that the date of 2009 is unfeasible.

The Ontario Mining Association supports the replacement of outdated technology that pollutes our environment such as the technology at the Lakeview Coal Generating Station. However, we feel the focus should be on harmful emissions not just closing plants.

The OMA Energy Committee has reviewed reports done by industry experts including professional atmospheric modeling by RWDI of Guelph. The studies show that current technology can be applied to existing coal power plants to make them very nearly as clean as modern, efficient natural gas turbine combined cycle power plants. Examining the difference between the cleaner coal and the natural gas, the modeling concluded that gas produced less ozone, and coal produced less fine particulate. However, differences were in the 1 to 2% range, and therefore it could be argued that the reduction were essentially similar.

Modern coal technology must continue to play a role in Ontario's supply mix and in fact already does. Since 2002 OPG has added selective catalytic reducers to remove about 80% of the NOx emissions on two units at Lambton and two units at Nanticoke at a cost of $250 million.

In April 2005, the Ministry of Energy released "Cost Benefit Analysis: Replacing Ontario's Coal Fired Electricity Generation". We feel the value to Ontario of supply diversity was not evaluated fully and the option of clean coal, ignored totally. Because the report recommends a significant reduction in fuel diversity, the risk and potential cost of such a strategy should be discussed. Cost not only to large industrial users like our members but also the average

household. For Ontarians to make a decision on the need to remove a fuel type completely from the mix, they need to know the environmental and the financial ramifications.

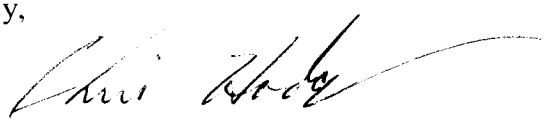
Further, Ontario's commitment to phase-out coal is out of step with trends in the US. The forecast in the US is that coal will continue to be the largest fuel source electricity production and that electricity production from coal will rise over the next 20 years. A staggering fact given recent statistics on the amount of Ontario's pollution that originates in the US, and our need to import their coal-generated power.

Also at this time, experts are telling us demand for natural gas in North America exceeds supply. We agree with IGUA's submission to the OPA that Ontario must decide whether it wants to rely upon an energy source for its future electric power generation that is bound to generate extensive periods of tight supplies with high prices and the potential for extreme volatility. If it does, the result will be reduced industrial activity in the province.

With regards to nuclear power, the OMA was encouraged to read Minister Duncan's comments this week in the Toronto Star. The Minister said the province needs to have a larger base of generating power to meet its needs, "and nuclear is an important component of that." This summer we have seen the system repeatedly exceed historical maximums. Clearly to meet the growing need for base load generation (in addition to the phase-out of coal), Ontario will have to consider capacity from new nuclear.

In closing let me say thank you again for allowing the Ontario Mining Association to provide input into your recommendations for the government. Supply mix affects not only price but also reliability and as such, our members ask you to consider the needs of industrial users.

Sincerely,



Chris Hodgson
President

cc: John LeMay, Chair, Ontario Mining Association Energy Committee
Adam White, President, Association of Major Power Consumers of Ontario
Peter Fournier, Industrial Gas Users Associations

ONTARIO POWER GENERATION

Bruce Boland
Senior Vice President
Corporate Affairs

700 University Avenue, Toronto, Ontario M5G 1X6

Tel: 416-592-4480 Fax: 416-592-6600
bruce.boland@opg.com

August 26, 2005

VIA EMAIL

Ontario Power Authority
175 Bloor Street East
North Tower, Suite 606
Toronto, ON M4W 3R8
Email: supplymixsubmissions@powerauthority.on.ca

Dear Sir or Madam:

Supply Mix Submission of Ontario Power Generation

In response to the *Call for Written Submissions* issued by the Ontario Power Authority (OPA) on July 4, 2005, please find attached the submission of Ontario Power Generation (OPG). OPG appreciates the opportunity to provide stakeholder input to the OPA with respect to the appropriate mix of electricity supply sources to satisfy the demand in Ontario.

Please contact me if you have any comments or questions on our submission, and I look forward to an ongoing dialogue on this matter.

Yours truly,

Bruce Boland

Att.

cc J. Hankinson, OPG

OPG Submission to the Ontario Power Authority

Introduction:

Ontario Power Generation Inc. (OPG) is an Ontario-based electricity generation company whose principal business is the generation and sale of electricity in Ontario and to interconnected markets. Our focus is on the efficient production and sale of electricity from our generation assets, while operating in a safe, open and environmentally responsible manner.

OPG appreciates the opportunity to provide stakeholder input to the Ontario Power Authority (OPA) with respect to the appropriate mix of electricity supply sources to satisfy the demand in Ontario. In reference to the OPA's *Call for Submissions*, OPG will limit its comments to the third of four "issue areas" only (assessment of different supply technologies and resources).

Fuel Mix - Process Considerations:

OPG notes that the OPA's general approach to long-term resource planning "will focus on explicit assessment of risks and exposure and recognition of the value of flexibility". Further, the approach "will develop and evaluate different portfolios of supply sources and conservation options", which will then be "evaluated against certain criteria". OPG supports this approach, and would like to propose certain criteria for inclusion within the portfolio evaluation. A decision on the weighting of these criteria, and trade-offs amongst them (and others depending upon stakeholder outcomes), will be determined by the Province in consultation with the OPA, but must be informed by stakeholder input as part of an open and transparent process.

- Safety, Reliability and Adequacy of Supply – Clearly of importance, the continued safe, reliable and adequate supply of electricity and reserve

must be a key consideration in any evaluation. The reliability criterion that is used for planning purposes, and how it is established, is critical.

- Diversity of Fuel Mix – An appropriate portfolio of fuels can help to mitigate volatility in single fuel prices (such as natural gas), dry water years, etc. Further, a diverse fuel mix within the portfolio can also mitigate physical risks associated with delivery of fuel.
- Economic Costs – Both capital and operating costs must be considered when assessing elements of each portfolio. There are a variety of measures for assessing this such as Levelized Unit Energy Cost (LUEC), consumer price impact, etc.
- Geographic / Power System Location – Provision of power alone is insufficient to ensure security of supply. Infrastructure analyses must be undertaken to understand geographic or system constraints with respect to location of generation and infrastructure upgrades. Within this context, consideration should be given to the reliability issues associated with long distance transmission lines, and to reliance on out-of-province supply sources (i.e. imports from other jurisdictions). Some specific considerations with respect to locational issues are discussed in more detail below.
- Technological Attributes / Limitations – Different supply technologies have different limitations associated with them. While all are capable of generally producing power, the limitations of each require that a portfolio approach be utilized to ensure that supply is available when required, and that the system has sufficient load-following capability. Some specific considerations with respect to limitations are discussed in more detail below.
- Environmental Impacts – Compliance with environmental legislation must be factored into the long-term resource plan. It should be recognized that both legislation and technologies dealing with environmental issues can change, over time.

- Social Considerations – Impacts on communities must be considered when assessing different portfolios.
- Product being Supplied – It is important to realize that there are different products that are provided by generation. The need for energy, capacity and ancillary services (or combinations thereof) must be considered.
- Timeframe for Assessment – A critical component for the evaluation. Selection of an inappropriate timeframe for consideration could preclude viable technologies from the evaluation. OPG suggests a timeframe of 10 to 15 years to accommodate all required design phases, approvals consultations and construction/commissioning activities. Of course, when total service life and decommissioning periods are considered, the overall time horizon is significantly greater than the 10-15 year period. It should be recognized that deciding to go forward with a given initiative requires a capital commitment that can extend for well in excess of 50 years.
- Flexibility – Since forecasts are not always correct and events do not always transpire as expected, flexibility must be maintained to adapt to changes as they occur. The ability to modify portfolios and processes in response to these unforeseen changes is of value.

Different portfolios can be constructed for consideration that may address some criteria more directly than others. For example, a portfolio could be constructed that has long-term cost minimization as its primary consideration while another may be heavily weighted toward short-term price impact minimization. Careful analysis of different types of portfolios will assist in determining the appropriate weighting to be applied with respect to the evaluation criteria.

In evaluating each potential portfolio against the above criteria, the OPA should consider the inherent uncertainties that exist in any long-term evaluation and assess the risks accordingly. Sensitivity analyses and contingency planning are critical in any long-term assessment to ensure that adequacy will be maintained, even in the event of unforeseen or unlikely circumstances. In assessing

flexibility, and the value of providing it, the OPA may consider using techniques such as Real Option analysis. Further, OPG looks forward to additional information from the OPA on a process for updating the resource plan as decisions are made, options selected, and changes occur.

Technology - Content Considerations:

With respect to an assessment of various supply technology options, OPG wishes to reiterate its general support for the portfolio approach to integrated resource planning. Different technologies exhibit different attributes that make them particularly suited to fulfilling baseload, intermediate or peaking roles within a power system. Each of these roles is critical in ensuring reliability of supply and operational stability.

OPG would like to elaborate on some of the technological implications and locational issues that should be considered when formulating the different portfolios for evaluation.

- Dispatchability – Not all units are dispatchable within the IESO-administered market. Additionally, some technologies have more difficulty (or are incapable of) following load. As such, they are reserved for baseload operation or self-scheduling status. As a result of increasing the amount of energy from such units, existing units within the market that currently perform intermediate or peaking functions will become even more critical in following load[1]. The existing 5 minute dispatch methodology already causes maintenance and operations concerns for intermediate and peaking units; a proportional increase in baseload or self-scheduling capacity will only exaggerate this issue for the existing dispatchable fleet.

[1] With the planned retirement of Ontario's dispatchable coal fleet, the value of dispatchable generation will be at even more of a premium.

- Ramp Rates – Different technologies have different abilities with respect to the rate at which the generating unit can be loaded. Typically, hydroelectric units can be loaded more quickly than steam or gas units based on their design. Particularly during morning peaks, the issue of ramp rate can be a significant determinant of which units are capable of meeting demand and which are not. As with dispatchability, without due consideration of ramping capability, the existing units could be even more heavily relied upon going forward – a situation that creates concern with respect to operations, maintenance and asset life.
- Operational Efficiency – Hydroelectric units, in particular, have specific operating points that maximize the efficiency with which they generate electricity. Operation off these points is less efficient and wastes water. This should be considered when dispatching these units in the system. Similarly, hydroelectric stations that exist on the same river cannot be viewed in isolation. These "cascading river" systems must be considered in aggregate, since changes at one station affect all the stations that exist downstream with respect to water conditions.
- Minimum Output - Combined cycle plants cannot operate with all generators on-line when their output drops below approximately 60%. For other single cycle technologies, the minimum output is typically approximately 25%.
- Size – Economies of scale and available equipment sizes usually means there is a practical size range for various technologies:
    - Nuclear (new) - 1,000 – 4,000 MW station made up of multiple units, notionally in the 1,000 MW range.
    - Combined Cycle – 500 – 1,500 MW stations made up of multiple trains in the 250 MW range.
    - Biomass - <200 MW units, usually limited by fuel availability.
- Gas Infrastructure Issues - Careful consideration must be given to gas infrastructure issues to help ensure generators can effectively procure and deliver gas to their plants when needed. It is hoped that the OEB's Gas

Electricity Interface recommendations will alleviate some of the issues associated with differences in the gas and electricity markets. Gaseous fuels, such as natural gas, landfill gas, and biogas cannot be stored on site. Consequently, the fuel delivery can dictate the electrical generation.

- There are locational considerations with certain technologies. Natural gas, for instance, is not available in all areas of the province, and in many areas where it is, the delivery infrastructure is insufficient. Coal requires a significant rail or waterway infrastructure, and biomass and other renewable technologies are often located at the fuel/energy source. Further, there are locational benefits associated with generator siting in proximity to load and this must also be considered.

In addition to these considerations, certain fuels, in particular, oil, natural gas and wood waste, have significant markets other than electricity generation. Consequently, the price tends to be much more volatile and electricity generators will have to compete against other markets for the fuel.

Specific Comments on Generation Technologies:

Nuclear:

Within the portfolios being formulated for consideration, OPG believes that consideration should be given to Nuclear, both refurbishment of existing facilities and new build. Nuclear technology scores well in a number of the evaluation criteria referenced above. Nuclear energy is a safe, economic source of virtually emission-free energy, well suited for baseload generation.

Hydroelectric:

Expansions to existing hydroelectric facilities, in particular, is an area that deserves consideration within the portfolios being formulated. The Niagara Tunnel Project is an example of just such an expansion. The tunnel will allow the Beck generating facilities to more effectively utilize available water, and is expected to increase annual generation on average by about 1.6 TWh. This

addition will come with minimal environmental impact and increases dispatchable generation within the province. Other such opportunities should be investigated and encouraged, as should viable new build opportunities that may exist. Within the OPA's deliberations, hydroelectric, as a generation technology should be considered to be renewable.

Thank you for the invitation to provide advice to the Ontario Power Authority (OPA) on the future energy supply mix for the province of Ontario. As we understand the process, this is the first of several elements of the OPA's Integrated Power System Plan. In that context, INAC believes that issues affecting remote off grid communities, need to be considered in the overall Integrated Power System Plan.

Within the scope of the supply mix consultation, we would like to comment on the 2nd and 3rd components which address the addition of renewable energy and the appropriate supply mix.

The remote north off grid communities in Ontario receive energy through community diesel generation systems. Annually, 28 million litres of fuel are consumed, travelling primarily over winter ice roads or by plane, resulting in 74 million kilograms of carbon dioxide emissions. Overall, $32 million in provincial and federal dollars are spent on these systems each year.

With regard to renewable generation and transmission system expansion, there are demonstrated opportunities for renewable energy generation in the remote north off grid communities such as water, wind, biomass and solar power. There is also a growing interest in developing these kinds of renewable generation options in the remote north.

In addition, opportunities also exist for some communities to become part of the provincial transmission grid system.

These two options--renewable energy generation and inclusion in the provincial transmission system--would reduce diesel fuel consumption and help in meeting Canada's commitment to Kyoto.

INAC understands that the proposed supply mix will form part of the Integrated Power System Plan for the next 20 years. We recommend that the remote north off grid communities be considered in supply mix plans and the overall Power System Plan for Ontario.

Should you have any questions regarding our input or wish to discuss the energy issues affecting Ontario's off grid northern communities, INAC officials are available to work with the OPA.

Thank you.

Ontario Region INAC

ONTARIO SOCIETY OF PROFESSIONAL ENGINEERS

cc Gia Sandra Neil.

SEP 14 2005

September 12, 2005

Amir Shalaby, P. Eng.
Vice President, Power System Planning
Ontario Power Authority
175 Bloor St. E.
North Tower, Suite 606
Toronto, ON
M4W 3R8

Dear Mr. Shalaby,

I am writing on behalf of the Ontario Society of Professional Engineers to comment on the Minister of Energy's specific requests and the OPA's 'specific areas' as outlined in the Call for Written Submissions related to "Supply Mix" of July 15, 2005. The Ontario Society of Professional Engineers (OSPE) is the voice of the engineering profession in Ontario. We advance the professional and economic interests of our members by advocating with governments, offering valued member services, and providing opportunities for ongoing professional development.

Thank you for allowing OSPE input in OPA's long-term power system planning. Our response is as detailed below:

Summary
Planning, approval and construction of new supply and transmission generally requires substantial lead times – usually at least five years and more frequently ten years or more. As has been experienced in the mid 1970's and early 1990's, the demand for electrical energy can change rapidly in response to global economic issues – quickly invalidating (Ontario based) long term plans and construction-in- progress. The OPA has requested input on supply options over a twenty-year time horizon. This is more than enough time for current changes in the global economy to radically affect power planning in Ontario. It is recommended that demand planning be done in the context of a global economic model to fully define the supply requirements and risks.

Furthermore, experience in other countries has shown that public participation in conservation programs increases with electricity price and the competitiveness of renewable energy, also improves with electricity price. Ontario's resource based economy, which contributes about 40% of Canadian GDP, has been fuelled by cheap power. Erosion of this competitive advantage may affect decisions by these industries to

4950 Yonge St., Suite 502, Toronto, ON M2N 6K1 p 416.223.9961 f 416.223.9963 tf 1.866.763.1654 w www.ospe.on.ca e info@ospe.on.ca

continue investing or operating in Ontario. Further economic modeling is strongly suggested to determine what the increase in conservation would be with energy price increases and whether this gain is worth potential losses in the forest products, mining, steel and auto business sectors.

Demand Estimation

Prior to 1973, energy demand in Ontario grew at a steady 6%, except for a major dip around the Second World War. In 1973, the oil crisis and the emergence of OPEC reduced demand immediately by 3%. More recently, the early 1990's saw the 3% growth rate reduced to 1% +/-. This coincides roughly with the global emergence of Internet and cheap fibre-optic telecommunications that has facilitated the shift from manufacturing to service-based trade. To summarize, in the past century, energy demand in Ontario has been only affected by global events – specifically international conflict, oil pricing and technology development.

Currently, the world is moving towards an oil shortage with potential for development of alternative fuels, such as hydrogen, in the offing. Trade patterns are expected to undergo a major shift with the emergence of India and China as significant forces. Beyond the impact of information technology, fuel cell technology is expected to become fully commercial in 2010. Not to mention the potential for terrorist-launched conflicts. Any of these factors can, based on past experience, have a major effect on energy demand.

To assess and plan for these risk factors, we believe that global economic modeling is required. In addition, planning to convert the Ontario infrastructure to facilitate the use of hydrogen could allow surplus energy to be stored (in the form of hydrogen) and change the energy market by productively using peak power. With home power and/or neighbourhood generation to use the hydrogen and supplement central generating stations, the need for peak power could be substantially reduced. The approximately 10,000 MW of coal and imports at peak system use could be supplied in the longer term, 2020 to 2025, by base load generation whose output could be switched between power supply and hydrogen production.

Energy Conservation

While some foreign jurisdictions have had success in energy conservation programs, adoption has been limited in Ontario. Cheap energy in Ontario has certainly been a barrier in the past. There may also be some cultural factors such as public information programs and incentives at work in these other jurisdictions, that supported the success of their programs. This is also an area where economic modeling-taking price versus program penetration and associated factors into account – could help set achievable targets for Ontario conservation efforts.

Energy Supply

As with energy conservation, other jurisdictions have had more success in promoting renewable energy technologies than Ontario, or for that matter, Canada. Again, these markets have higher electricity prices, different incentive programs for technologies such as co-generation, wind, solar, and different cultures around power use. A comprehensive economic model could capture these factors and assist the OPA in setting achievable targets for renewable energy in an Ontario context.

As noted above, current technology trends could support a major shift in generation to base load generation. The total energy requirement could potentially level off in the 28,000 to 30,000 MW range. This is particularly achievable if conservation targets, currently set at 5% or 1300 MW, are met or exceeded. The base load component, likely to be supplied by new nuclear sources, will be the total minus dependable renewable energy sources, minus fuel cell generation, minus base and peaking hydroelectric (which hopefully includes about 2,000 MW from Manitoba and Churchill Falls), minus other standby peaking facilities and any makeup to replace nuclear facilities that cannot be life extended during the intensive rehabilitation cycle from 2009 to 2020.

Availability of Engineering Services

We would like to emphasize the broad range of expertise available in the Ontario engineering community. This expertise can be used to create sufficient renewable energy sources and take advantage of other supply options and opportunities for co-generation. This, in turn, could lead to employment opportunities and economic prosperity to Ontario.

Conclusion

We believe that comprehensive economic modeling of the global economy needs to be undertaken to better understand demand estimation, the supply mix, and reasonable conservation goals for Ontario. We also have available detailed demand data since 1922 in Ontario, and would be happy to share this data with you and discuss our observations in more detail.

If you would like to set-up a meeting or have any questions regarding our submission, please contact Hanan Jibry, P.Eng., our Director of Policy and Government Relations, at (416) 223-9961 ext. 236, or hjibry@ospe.on.ca.

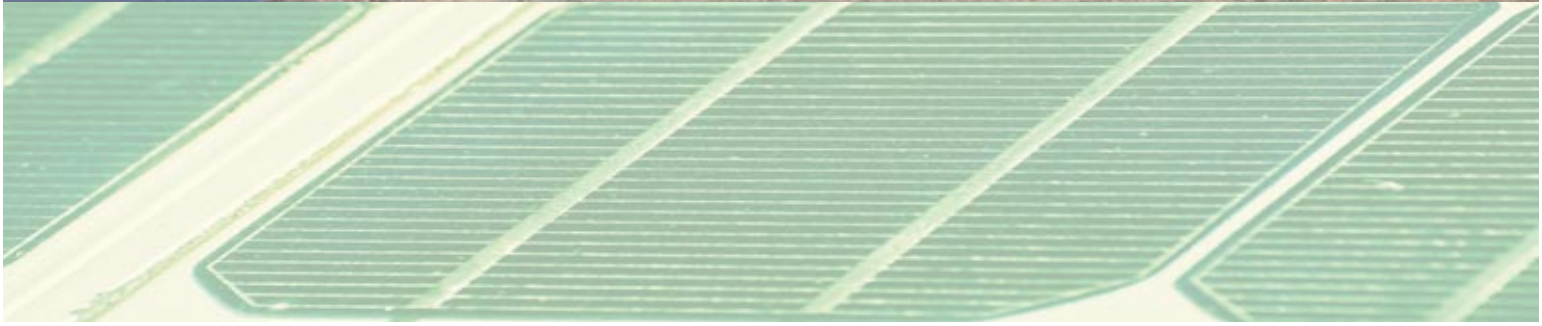
Yours truly,

C.B.H. (Chris) Cragg, M.A.Sc., MBA, P. Eng.
President and Chair
200578

OSEA

Powering Ontario Communities: Proposed Policy for Projects up to 10 MW

A co-operatively owned wind power plant within the city of Copenhagen



Study Outlining Policy Options to Encourage Small or Community-Owned Renewable Energy Generation in Ontario

Prepared by the Ontario Sustainable Energy Association for the Ontario Ministry of Energy

May 2005

Authors:
Paul Gipe
Deborah Doncaster
David MacLeod

Editors:
Brent Kopperson
David MacLeod
Sarah Miller
James Murphy
Melinda Zytaruk

Reviewers:
OSEA would like to thank all reviewers for their valuable feedback and suggestions. A full list of those consulted is found in Appendix B.

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Executive Summary

The Ontario Sustainable Energy Association (OSEA) was asked by the Ontario Ministry of Energy to examine the criteria for a pilot program offering standard supply contracts to small or community-based renewable power projects.

The Ministry's recent 300 MW Request for Proposal (RFP) for renewable energy was intended to launch development of the province's renewable energy strategy. Inherent in this was the understanding that the tendering process lent itself to large-scale projects by a small number of large developers. Subsequent to the successful closing of the RFP, the province has indicated a commitment to engage the small or community-based renewable energy sector in a pilot program to develop distributed generation.

There is growing recognition that a mechanism other than the tendering process is needed to foster development of distributed generation rooted and responsive to the local community. Furthermore, European experience indicates that small, distributed projects with community or local participation result in more renewable energy developed more quickly and increases the public's acceptance of the technology.

The preponderance of the 16,600 MW of wind generating capacity operating in Germany today are installed in small projects (less than 10 MW) distributed across the landscape. Many of these projects were developed with local or community participation.

Key Program Recommendations

Based on comprehensive research gathered from best practices around the world, along with consultation with a wide range of stakeholders in Ontario, OSEA has concluded that the optimal approach is a Standard Offer Contract (S.O.C.) mechanism. The cornerstones of this model are 20-year fixed-price contracts for eligible projects, and the right to interconnect to the grid. These core components are underpinned by a rigorous and transparent pricing model that can be applied to all forms of renewable energy. The pricing model provides minimum profitability at sites with moderate resources to stimulate strong and distributed market growth while at the same time it precludes undue profits at sites with energetic resources.

Standard Offer Contract programs work best when total built capacity is not capped as capping leads to gaming and hoarding. The OSEA proposal provides other options for controlling the total amount of renewable energy brought on stream through the S.O.C. program.

Individual projects may be capped at 10 MW. While an initial 10 MW project limit may be too low in light of today's multi-megawatt wind turbines and some hydro projects, the recommended review period can allow for this to be revisited and remedied if necessary. However,

Mitigating Supply Risks

A Standard Offer Contracts will reduce the province's supply risks that are inherent in the RFP process. Experience elsewhere indicates that only a percentage of winning bidders in tendering systems actually build projects. In some cases, such as Great Britain and France, the percentage of contracts executed is a fraction of those awarded.

Only 30 percent of contracted capacity under Britain's tendering system was actually installed. Between 1990 and 1998 the British government awarded contracts for 3270 MW of wind energy. By 2003 only 960 MW had been built.

In France's Eole program, of the 300 MW in contracts awarded only 70 MW were built. And of those only 30 MW are still operating under the original contracts. This was an important reason why France switched from a tendering system to a system of Standard Offer Contracts.

A recent study produced by the Cambridge – MIT Institute reaffirms numerous other papers comparing tendering mechanisms with Standard Offer Contracts to support wind power development. The paper concludes that tendering systems may not result in the contracted supply being built.

the review should consider *only* whether the limit should be raised, not lowered.

A complementary program to support community power adopted in some jurisdictions is a revolving public fund to support early stages of project development. Ontario's Ministry of Energy has given consideration to the development of a public fund for community projects. OSEA was asked to comment on this, and has provided recommendations for consideration. OSEA's recommendations can be found in Appendix A.

Worldwide wind prices ($CAD/kWh)

Germany	$0.14
France	$0.135
Spain	$0.106
UK	$0.14
Italy	$0.18

Ontario has no reason to expect to be able to build wind energy for less than the rest of the world. In fact since the majority of the technology is imported from Europe there are likely to be additional costs for Ontario.

Proven Success Worldwide

Renewable energy policy mechanisms incorporating these common core features have proven to be the single most successful mechanisms for the rapid development of renewable energy throughout the world. The vast majority of the wind power developed in Denmark, Germany and Spain, which account for approximately two-thirds of all wind capacity worldwide, came about through Standard Offer Contracts.

Not only has this policy mechanism resulted in more renewable energy generation than any other policy, but has also incubated a whole new manufacturing sector by allowing a steady flow of manufacturing orders from many and diverse project developers. As a result, Standard Offer Contract systems have lead to significant job creation. In Germany, 45,000 people are employed in the wind industry alone, and this is forecasted to grow to 110,000 by 2010.

This success contrasts sharply with the inherent boom and bust cycle experienced where periodic project tenders (RFPs) have been the prevailing policy instruments.

Delivering Economic, Environmental and Social Benefits

Standard offer contracts provide a wide range of economic, environmental and social benefits for the province, including:

- Increased distributed generation resulting in improved system reliability, stability, and reduced line losses
- Increased rural investment at the local level
- Greater potential for attracting new manufacturing
- Addition of new skilled jobs
- Improved air quality
- Greater public awareness and acceptance of renewable energy
- Greater access to local and regional sources of capital
- Increased tax revenue
- Reduction in pressures for urban sprawl
- Greater certainty for investors
- Complete transparency

- Increased diversity and number of market players and investors
- Simplified program administration that reduces government costs
- Improved policy flexibility for achieving renewable energy targets
- Greater mitigation of supply risks

Program Cost

There is little or no cost anticipated for the provincial treasury. The prices for the power delivered under Standard Offer Contracts are incorporated into overall system pricing and borne by the ratepayer. The streamlined nature of the process will require minimal ongoing administration on the part of the ministry once the program is implemented

The maximum cost to Ontario ratepayers is expected to be $.00050 (approx. five one hundreth of a cent) per kilowatt-hour from 1,000 MW of wind generating capacity in year 20.

Program Implementation Timing

OSEA recommends that this program be implemented immediately following internal review and public consultation. There is extensive experience in Europe with Standard Offer Contracts and the details of the proposed approach have been well documented in other markets. This knowledge permits the program to move forward in a timely manner. Early implementation also ensures that the province benefits from development of additional renewable energy capacity by the first renewable energy milestone in 2007.

Furthermore, while OSEA was contracted to look at potential policy mechanisms for small community based renewable energy projects, through our research we have come to the conclusion and recommendation that S.O.Cs be applied to the entire renewable energy market.

OSEA has extensive expertise in how Standard Offer Contracts are being used elsewhere and is ready to assist the Ministry of Energy further as needed.

Key Details of Pilot Program

Pilot Program Component	Recommendation
Objectives	● Broad participation ● Stable market ● Rigorous pricing model ● Applicability across all renewable technologies ● Simple, streamlined, cost-effective process
Eligible Technologies	● Wind, small hydro, biomass, solar PV
Eligible Participants	● Inclusive; e.g. farmers, rural landowners, community-based organizations, co-ops, First Nations, NGOs, municipal entities, private individuals, small businesses
Contract Design	● Simple, transparent, basic terms of pricing, interconnect
Contract Term	● 20 years; provision for extension at end of term
Project Size	● Include all projects up to approx. 10MW, connected to 44kv or less distribution voltages
Overall Pilot Project Limit	● Self-limiting, no capacity cap required; initial pilot end date 2010, review after 2 years
Pricing	● Fixed price contracts; pricing based on specific technology and rigorous and transparent pricing model; inflation adjusted for 15% of price
Contract Application	● Simple application process, site control required and Allocation Process ● Awarded on first come, first serve basis ● Options available to discourage hoarding, speculation
Interconnection	● Guaranteed right of interconnection, simple terms ● 90 day application response from relevant utility ● Developer responsible for costs to point of interconnection; network upgrades (if required) borne by system
Pilot Review	● Pricing & process review after year 2 ● Evaluation of rate of development under pilot versus expectations ● Participants required to report on performance with production data ● Any wind data to be provided to province for public benefit
Program Administration	● Initially by Ministry of Energy staff, later Ontario Power Authority; Ombudsperson for disputes, coordination
Timing	● **Pilot should be implemented immediately** ● Internal review, consultations, program details within 60 days, program implemented in 90 days

1. Introduction

The Ontario Sustainable Energy Association (OSEA) was asked by the Ontario Ministry of Energy to examine the criteria for a pilot program offering standard supply contracts to small or community-based renewable power projects.

The Ministry's recent RFP was successful in winning low-cost bids from proposals for large, central-station plants. These projects, if completed, will provide low-cost renewable power to the province, and are a positive first step in achieving the goals of increased generation from renewable energy and cleaner air. However, it is felt that they may not provide all the non-price benefits that dispersed renewable technologies can provide, nor spur a new provincial manufacturing sector. In part, this is because an important sector of the market was unable to participate.

The small/community-based renewable energy sector did not participate in the Ministry's 300 MW renewable energy Request for Proposal (RFP). The RFP's complex bidding process posed a significant barrier for farmers, community groups and others with small renewable power projects interested in helping the province meet its renewable energy targets.

A program that levels the playing field and taps into the interest and investment dollars for small renewable power projects can further advance the province's goals and deliver additional benefits. **Small renewable energy projects dispersed across the province may offer the benefits of distributed generation, pump more of the project development dollars through rural economies, increase public awareness and acceptance of renewable energy, and provide a stable domestic market for renewable energy technology that can spur regional manufacturing industries.**

OSEA was asked to identify and co-ordinate with stakeholders representing disenfranchised small renewable energy producers to draft a pilot program. The pilot program is intended to offer standardized contracts to meet both their needs, and the needs of the province for new sources of electrical supply.

OSEA was also asked to propose specific prices that might be used in Ontario's Standard Offer Contracts (SOC). Toward that end, OSEA sponsored a workshop with an internationally-renowned renewable energy economist to derive fixed-prices that could economically drive distributed development of small renewable power projects.

Ontario is at the forefront of non-European jurisdictions considering standard supply contracts offering long-term fixed prices. Through the province's unique ability to use ministerial directives, Ontario has the opportunity to demonstrate continued leadership in renewable energy by acting sooner than any other North American state or province in establishing Standard Offer Contracts. This can position the province to lure new manufacturing jobs and play a central role

in determining the direction of renewable energy development on the continent.

The following report outlines the features of Standard Offer Contracts, the rationale and benefits of this mechanism, and the suggested framework for the implementation of a successful pilot program.

2. Engaging Ontarians In Meeting the Need

OSEA's experience in working with communities across the province demonstrates that there is a significant untapped opportunity to engage participation in the development of small, distributed generation projects. The current one-size-fits-all RFP model will not take full advantage of the opportunities for new generation, especially those for new generation added at the distribution level, and the associated benefits. While the opportunity is there, it is critical to remove the current barriers in the system and to create a level playing field.

2.1 The Opportunity At Hand

While small renewable energy projects certainly help the government meet broad objectives such as cleaner air and improved energy supply, they also offer a unique set of additional benefits to the province:

Improved Reliability and Stability of the Electricity System
Standard Offer Contracts will encourage more distributed generation across the province, closer to the load. This diversity in technologies as well as geographies will reinforce the stability of the system and reduce the vulnerability to centralized failures. A more distributed system also means reduced wear and strain on the transmission system, resulting in lower maintenance costs. It has been estimated that the system-related benefits of distributed generation are equivalent to approximately $0.01/kWh.

Improved System Efficiency through Reduced Line Losses
By being closer to the load, the efficiency of the overall system improves as line losses are reduced. Given that the average line losses for the province are estimated at 9%, this can be a significant benefit to the overall system efficiency.

Avoidance of Transmission System Constraints for Faster Deployment
Since the Standard Offer Contracts will be focused on connecting to the distribution system, these projects will more likely not face the same challenges posed by larger projects dealing with costly and timely transmission bottlenecks. The result will be faster implementation of renewable energy.

Increased Rural Investment
Farmers, other rural landowners, community groups, co-operatives, First Nations, and rural businesses and industry could all potentially benefit from a steady supply of Standard Offer Contracts with sufficiently attractive prices that would drive investment in their local

communities. This investment would produce both direct and indirect spin-offs.

New Skilled Jobs
With the more stable market that Standard Offer Contracts provides, manufacturers are more inclined to establish production and operations facilities. Unions, skilled and unskilled labour, and recent university graduates could benefit from introduction of new manufacturing and service activity by companies supplying the wind turbines, hydro-electric generators, and photovoltaic panels needed to meet the demand created by Standard Offer Contracts. Denmark, Germany, and Spain have used renewable energy as a major engine for job creation.

Cleaner Air
The incremental generation from community-scale renewable energy will further displace fossil fuel sources and contribute to the province's ability to close coal-fired plants as part of its commitment to improve the quality of air in Ontario.

Greater Public Acceptance of Renewable Energy
Experience has shown that community involvement in smaller distributed projects ultimately leads to greater awareness, education and acceptance of these new technologies. This not only lessens the "NIMBY" factor for smaller projects, but helps to pave the way for all projects.

Increased Sources of Capital
By their very nature, community-scale projects will tap into local community capital to finance development. Whether it is equity provided by farmers, co-operatives or small businesses, or debt provided by local banks, credit unions and farm financing agencies, the pool of available capital for renewable energy is significantly expanded.

Increased Tax Revenue
Increased economic activity in rural areas would generate incremental tax revenues.

Policy Flexibility in Reaching (or Exceeding) Renewable Goals
The Ministry of Energy would benefit by the addition of another policy tool that can be used alongside existing policy options, such as the tendering system, to meet the goal of closing the province's coal-fired power plants, and reducing the need for electricity imports. Standard Offer Contracts can provide incremental generating capacity, either to serve as a buffer in the event that certain larger projects are delayed or stopped, or to help surpass the targets.

The province's RFP process has inherent risks in meeting objectives. Experience elsewhere indicates that only a percentage of winning bidders in tendering systems actually build projects. In some cases, such as Great Britain and France, the percentage of contracts executed is a fraction of those awarded. In France's Eole program, of the 300 MW in contracts awarded only 70 MW were built. And of those

only 30 MW are still operating under the original contracts. This was an important reason why France switched from a tendering system to a system of Standard Offer Contracts.

By not engaging the rural business sector in providing new supply, the province may be losing financial, transmission, and system reliability benefits, as well as indirect economic and social benefits associated with local manufacturing, local job creation, local business development and local acceptance.

2.2 Barriers to Participation in Meeting Supply

While all these benefits can accrue to the province from smaller scale projects, the current renewable energy process presents significant barriers. Individuals, community groups, farmers, co-operatives, small businesses and First Nations were unable to bid into the Ministry's recent RFP. The legal, financial, and interconnection requirements of the RFP were too onerous for them to participate.

In addition, the process did not recognize the system benefits of reduced line losses and transmission life extension provided by distribution-connected projects. Small projects cost more, but they are *worth more* to the system. A procurement process must recognize the system benefits in its decision criteria. Best price is not always best value.

Investment Requirements
Renewable power projects demand significant investments in up-front expenses for project planning, resource assessments, and planning approvals. These costs are prohibitive for farmers, community groups, and First Nations, notably so when there is little assurance of winning a contract once the expenditure has been made. The process, by and large, favoured larger corporations with significant financial resources.

Uncertainty for Investors
Uncertainty also proved a barrier. Only a few bidders win contracts in tendering systems, which act, in essence, as a lottery. Many will not win. Investment and initiative thrive best when there is some certainty that the initiator will at least have the opportunity to prove themselves in the marketplace if they invest substantial sums in up-front development expenses.

"Lowest-Price" Criteria
The RFP, by its emphasis on price and price alone, discriminated against smaller projects. In a competitive bidding process, larger projects in the 50-100 MW range could outbid smaller projects on price, even though these smaller projects can offer other important financial and non-financial benefits. The price-only approach also precluded more expensive renewable technologies such as solar photovoltaics from bidding. The costs of solar photovoltaics are an order of magnitude greater than those for wind energy or hydro-

electric power, yet they can play a useful role in the renewable energy equation.

Burdensome Program Administration
Overhead expenses of the tendering systems are also borne by the province, and these costs should ultimately be reflected in the cost of electricity.

The complex process for managing the recent RFP consumed significant resources within the Ministry, including extensive use of outside consultants. This process obviously has a direct financial impact. Multiple tranches of tenders will continue to tax the resources of the Ministry.

Administration of standard offer systems has historically been less burdensome to the taxpayer than tendering systems. Simplified contracting using standardized contracts and fixed-prices streamline the contracting process and introduce more vibrant competition than the RFP process alone, where only large, sophisticated firms can participate.

Furthermore, an RFP system for smaller projects would result in a disproportionate use of Ministry resources to administer the process. So while the additional expense may be justifiable for larger projects, it does not make sense for smaller scale projects.

3. Study Methodology

In developing the recommended pilot program, OSEA undertook a series of actions to ensure the program reflected the most up-to-date and leading edge practices in the industry from around the world.

3.1 Research on Successful Programs Worldwide

OSEA has investigated the various policy mechanisms utilized for the development of renewable energy around the world. While in North America the tendency has been to competitive tendering processes and quotas such as Renewable Portfolio Standards, the research has clearly demonstrated that **worldwide, Standard Offer Contracts are the most prevalent and successful mechanism in stimulating distributed renewable energy.**

Specific examples of the countries using this mechanism and the key design elements are discussed in the *Background on Standard Offers* section.

3.2 Coordination with Stakeholder Groups

OSEA has coordinated its standard offer contract design with specialists in renewable energy technologies and has sought input from other NGOs working in the field of energy policy. OSEA received responses on its request for comments on proposed Standard Offer Contracts from some twenty individuals, firms, and NGOs in Canada,

the United States, and Europe. A detailed list of these participants is included in Appendix B.

This ensured the incorporation of a wide range of perspectives on the role and design of the program, and facilitated healthy debate on the various considerations that needed to be addressed.

3.3 Detailed Design Workshop

A key step in the process development was a Detailed Design Workshop that OSEA organized on January 10-11, 2005.

Bernard Chabot, an internationally-renowned renewable energy economist with France's national energy management agency, ADEME (Agence de l'Environnement et de la Maîtrise de l'Energie), lent his considerable experience and expertise to the proceedings. Mr. Chabot has been a leader in the design of Standard Offer Contracts in France and has worked with numerous other European jurisdictions in the design of similar programs. His experience was invaluable in addressing the wide range of practical implementation topics and to the effective financial modeling for price design.

Over 24 participants attended the workshop, including representatives from the renewable energy industry, provincial and national NGOs, and business leaders.

4. Background on Standard Offer Contracts

The following section outlines the key elements of Standard Offer Contracts including related terminology, the success of this mechanism worldwide, key principles for use and a survey of prices under these programs in various jurisdictions.

4.1 Terminology

Standard offer contracts are known by many names: Renewable Energy Tariffs, Renewable Energy Feed-In Tariffs (REFITs), Feed Laws, Minimum Price Standards, Minimum Price Systems, Fixed Price Systems, Standard Offer Contracts, Renewable Energy Premiums, and Renewable Energy Bonus Payments.

Standard offer contracts as used in Europe are the single most successful mechanism for stimulating the rapid development of renewable energy technology. Equally important, Standard Offer Contracts are the most egalitarian method for determining where, when, and how much renewable energy capacity will be installed by enabling farmers, co-operatives, and First Nations to participate on an equal footing with large commercial developers.

Tariffs are the term commonly used in electric utility rate making in North America to describe the price paid for electricity per kilowatt-hour consumed. The term is also commonly used in Europe.

Standard Offer Contracts in Germany and France are identified as Advanced Renewable Tariffs. In this usage, tariffs describe the price paid per kilowatt-hour for electricity generated by renewable sources.

In Germany, France, and Spain, Advanced Renewable Tariffs permit the interconnection of renewable sources of electricity with the electric-utility network and at the same time specify how much the renewable generator is to be paid for their electricity.

These Standard Offer Contracts or Advanced Renewable Tariffs (ARTs) are the modern version of **Electricity Feed Laws** that were developed in northern Europe in the late 1980s and early 1990s. ARTs differ from feed laws in several important ways. Feed laws set the price paid for renewable energy as a simple percentage of the retail tariff. For example, the German feed law stipulated that renewable sources of energy would be paid 90% of the retail rate. ARTs, on the other hand, are more sophisticated than feed laws and can be tailored to different renewable technologies and to different regions of a country. There are often several tiers or sets of prices per kWh depending upon the technology, the resource available, and how long the generator has been in service.

4.2 Standard Offer Contracts in Europe, North America and Beyond

Worldwide, the trend is growing toward Standard Offer Contracts because of their success at bringing large amounts of renewable generating capacity on line quickly at reasonable costs.

Europe: A History of Success

Denmark, Germany, and Spain accounted for nearly two-thirds of all the wind generating capacity in the world at the end of 2004. All three countries have had or now use Standard Offer Contracts. As a result of steady domestic market created by these Standard Offer Contracts, each has a dynamic wind turbine manufacturing sector (see Figure 1: Standard Offer Contracts Status)

Standard Offer Contracts Status

Existing	Proposed
Germany	Turkey (Wind)
France	Czech Republic
Spain	China
The Netherlands	India
Portugal	California (PV)
Austria	Italy (PV)
Brazil	PEI, Canada?
Greece	Ontario, Canada?
Luxembourg	Minnesota, USA?

Figure 1: *Standard Offer Contracts Status*

Germany alone accounts for one-third of total worldwide wind generation. The 16,600 MW of wind turbines operating in Germany at the end of 2004 was 2.3 times the total installed wind capacity of North America.

Ranked second worldwide behind Germany, Spanish wind development reached 8,000 MW at the end of 2004, more than 1,000 MW greater than in all of North America.

Like Germany, and Denmark before it, Spain's rapid development of renewable energy is due to its adoption of Standard Offer Contracts

in the mid 1990s. The Spanish tariff system was updated in early 2004 and now includes more renewable technologies, and more categories within each technology.

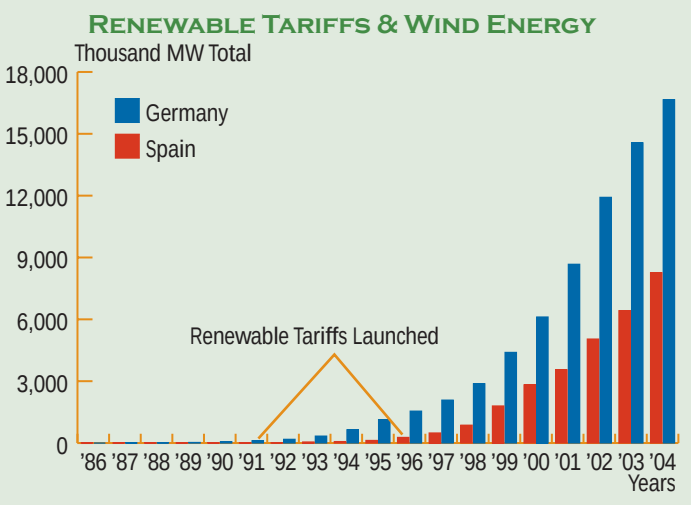


Figure 2:
Growth of Wind Energy in Europe due to Standard Offer Contracts or Renewable Energy Tariffs.

Unlike the Standard Offer Contracts used in France and Germany, Spain's system is based on a percentage of the retail price of electricity. For example rather than a specific price per kWh, small hydro plants less than 10 MW are paid 90% of the retail rate for the first 25 years of operation. Larger systems are paid less because of the lower costs gained by economies of scale (see Figure 2: Growth of Wind Energy in Europe due to Standard Offer Contracts or Renewable Energy Tariffs.)

While most attention is focused on wind energy, Standard Offer Contracts, especially in Europe, have been used to spur development of solar photovoltaics, biomass, and small hydro (see Figure 3: Growth of Solar Photovoltaics in Germany).

By the end of 2004, Germans were operating a total of 110,000 solar-electric systems, representing about 700 MW. Most of these installations are owned by individuals and small businesses and are capable of generating more than one-half billion kWh per year under German conditions. Because there is one-quarter more sunlight in Ontario than in Germany, the same number of solar panels would generate nearly 680 million kWh in the Canadian province. The German ministry for the environment reports that by the end of 2005 there will be some 15,000 people working in the rapidly growing solar industry.

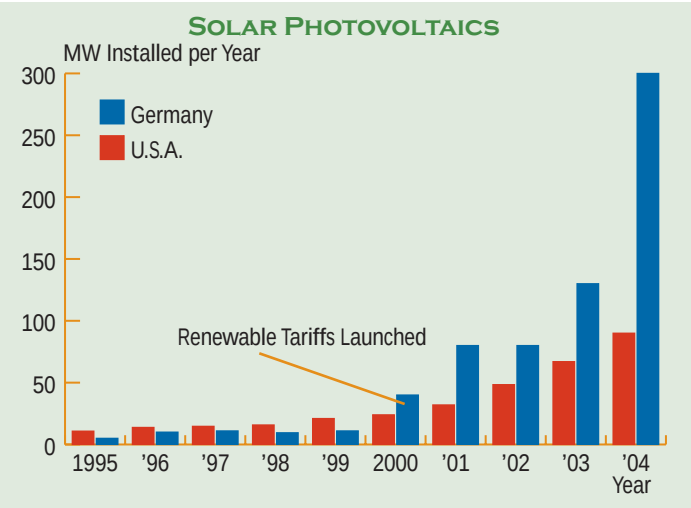


Figure 3:
Growth of Solar Photovoltaics in Germany

Renewable energy technologies installed under Germany's standard offer contract system now generate 30 TWh annually, supplying 5% of the country's electricity. Placed in southern Ontario, Germany's renewable power plants would today produce 20% of the province's electricity. Nearly all of this technology has been installed since 1991 when the Standard Offer Contracts were first introduced.

Because Germany's program is open ended, there is a stable and growing market for renewable technology. This has spurred employment in all technologies, not just in solar photovoltaics. There are 45,000 employed in the wind industry alone. Altogether, there are 135,000 people working in Germany's renewable energy sector.

Standard Offer Contracts in North America

Standard Offer Contracts for renewable power development were first introduced in California in the mid-1980's in response to obstruc-

tionist behaviour by the state's Investor-Owned Utilities toward small power producers. California's Public Utility Commission ordered the utilities to offer standardized contracts in co-ordination with small renewable power producers. One such contract, Standard Offer No. 4 (SO4) provided a schedule of fixed-prices. Within a few years, private power producers had installed 1,200 MW of wind turbines.

Currently, Minnesota, California, and Prince Edward Island are also considering some form of Standard Offer Contracts.

Trends in Emerging Markets

In Asia, China's Peoples' Congress will this year consider introducing a standard offer contract system like those in Europe. India's wind industry (the world's fourth largest outside Germany, Denmark, and Spain) has abandoned its bid for new tax credits and has chosen to support a call for Standard Offer Contracts.

5. Principles of Standard Offer Contracts

A number of key principles are essential to the effective functioning of a Standard Offer Contract System. As a system, it is critical to ensure that these elements are integrated in the program design. The absence of one or more of these principles will render the overall process ineffective.

Sufficient Contract Length, Reliability and Stability

Above all else, a system of Standard Offer Contracts must provide a stable market for investment. The pilot program envisioned here must be sufficiently long to assure the investment community and manufacturers that there will be a stable and ongoing market for their products. To provide the necessary program stability, contracts, once awarded, must not be revisited unless to improve terms or conditions, never to reduce payments or add additional burdens or requirements. Unfortunately, the previous turmoil in the Ontario market due to political interventions has shaken the confidence in the stability of the market for manufacturers and investors.

Stable Prices

Prices under Standard Offer Contracts must be stable and predictable. Farmers, community groups, First Nations, co-operatives and the local lenders who are likely to support them cannot take the risk of betting on a fluctuating market. Prices must be fixed, preferably indexed to inflation, and bankable.

Sufficient Pricing Levels

To function effectively, Standard Offer Contracts must provide minimum profitability at sites with moderate resources to stimulate strong market growth while at the same time not generating undue profits at sites with energetic resources. For example, with wind

China's Proposed Standard Offer Contracts

China's Peoples Congress is currently considering Standard Offer Contracts modeled after those in Europe. In reviewing the proposed law, Ryan Wiser of Lawrence Berkeley National Laboratory, made several observations that illustrate the essential features of successful programs. Wiser, an authority on market mechanisms for developing renewable energy, suggested that:

- there should be a fixed-term, based on differential prices for various technologies,
- the price and duration of the tariff should be sufficient to attract investment and result in increased renewable energy development, by offering a profitable return to renewable energy developers and project owners,
- the price should be known in advance by developers, and should be durable and stable,
- contract terms should have a minimum of 15 years,
- reductions in the price or changes to the policy should only be made prospectively for new contracts and not retroactively affecting existing contracts,
- programs require Standard Power Purchase Agreements (PPA) and Contract Terms,
- that a well-designed feed-in tariff will automatically lead to rapid renewable energy deployment by providing profitability to renewable generators and ensuring that the grid operator purchases renewable power.

If renewable electricity targets are not being achieved under the initial program, prices can be raised or other details improved to stimulate further development. Likewise, prices can be adjusted downward if it is felt there is a need to adjust the pace of development.

energy, contract prices should be adjusted on the basis of the annual specific yield (kWh/m2/yr) as is the case in Germany and France.

Simple, Streamlined Contracts

Equally important, the process for applying for and awarding contracts must be simple and timely. Contracts must also be available for several technologies: wind, small hydro, various forms of biomass generation and solar.

Simple, Streamlined Interconnection with the Grid

The process for these projects to interconnect must be simple, streamlined and assured.

The proposed pilot program should provide:

- Simple, comprehensible, and transparent contracts,
- Simplified interconnection,
- Sufficient price per kilowatt-hour to drive development,
- Contract length sufficient to drive development,
- Prices differentiated by technology, and
- Prices differentiated by available resource where applicable.

Costs Shared By Electricity Consumers

The premium prices paid under Standard Offer Contracts must not come from taxes. Not only are tax credits or other subsidies subject to periodic budgetary debates, they distort the electricity market. By passing the cost of the premiums onto taxpayers, the true cost of electricity is hidden from the consumer. For this reason, all jurisdictions successfully using Standard Offer Contracts spread the cost of the premium payments across all electricity consumers and specifically avoid passing the costs to taxpayers.

6. Available Pricing Policy Options

There are several pricing options for Standard Offer Contracts available to the province. In general, there are two main avenues that can be considered – a variable pricing approach based on relevant benchmarks, or a fixed price model. The relative merits and issues with these options are discussed below, with relevant examples from various jurisdictions.

6.1 Variable Pricing Models

Those models incorporating the spot market price, or the variable price of power purchased from outside the province, are the antithesis of the fixed-price contracts that are at the heart of the pilot program for small renewable power producers. Nevertheless, the spot market has been discussed as one means for setting the price of renewable energy and so is included here. There are a number of variations with this approach.

Spot Market or Wholesale Price

In this option, the price the renewable developer would receive is the current spot market price.

Issues:

- The current spot market price is insufficient to drive renewable development. The spot market price in 2004 was less than the average bid price of the renewable energy RFP.
- The proxy power plants on the spot market are coal-fired. The province's renewable energy development program is predicated on the policy of closing the coal plants and it would be ironic if the province closed the coal plants in Ontario only to use power from coal plants in the United States as proxies for the price of renewable power in Ontario.

Spot Market with Premium

The contracted price paid under Standard Offer Contracts could be determined by the spot market price per kWh plus a premium per kWh. The cost of premiums could be placed in the rate base of Ontario electricity consumers or the premium could be paid from the provincial budget.

Issues:

- Paying a premium through the budget process creates uncertainty and distorts electricity pricing by placing a portion of generating costs on the taxpayer, not the electricity consumer.
- Because of the variability in the spot market price, the premium must be higher than it would be otherwise to compensate for the uncertainty in the spot market price. The administrative effort needed to determine the necessary premium payment would be more fruitfully used to determine an appropriate price for fixed-price contracts.
- Prices must be sufficient to drive development without reliance on tradable credits or special pricing schemes that are subject to the whims of the public and the marketplace.
- Variable pricing does not provide a stable, predictable income stream that is sufficiently reliable so lenders will provide the debt needed to build capital-intensive projects such as wind, solar photovoltaics, and hydro plants. The result is that projects will require more equity, and less debt, and total prices offered will therefore need to be higher.

Spot Market Price with Tax Credit or Capital Subsidies

In this approach, the spot price would be supplemented with a tax credit or capital subsidies to try and provide the economic equation that would stimulate development.

Issues:

- As in the spot market price plus premium mentioned above, tax credits or capital subsidies would need regular appropriations or parliamentary action.

- Depending upon program design, tax credits may distort the investment market and discriminate against the very investors that the pilot program seeks to enfranchise: farmers, co-operatives, First Nations, or start-up firms with limited tax liability. The U.S. Production Tax Credit for wind energy has just this effect, precluding participation and favouring companies with large tax liabilities.
- Capital subsidies in dollars per kilowatt of installed capacity have historically been counterproductive in developing a dynamic and sustainable wind turbine manufacturing sector. However, they have been used with some effect in Japan and California in promoting solar photovoltaics with net metering. Paying for kWh encourages good performance.

Avoided Cost Pricing

Similarly, the province could determine the avoided cost of new power plants within the province and use this as a proxy for renewable energy.

Issues:

- As evidenced in the United States during the past two decades this strategy is problematic and requires lengthy analysis of the costs of generation from other sources, notably nuclear power, through costly administrative or quasi-judicial proceedings.
- In the end such proceedings only determine what the estimated costs are of plants avoided and not built rather than the cost of the power plants desired.
- If the objective is to spur renewable energy development, administrative time and money would be better spent identifying the prices that would drive renewable development in the province – which is the direction of the proposed pilot program.

Avoided Cost Pricing with Premium

This approach still requires the cumbersome determination of avoided cost, along with the establishment of a premium to make investment in renewable energy attractive.

Variations of this approach are in use in Minnesota, the Netherlands and California (for solar).

Minnesota

Minnesota uses this approach for its community wind contracts within the Xcel franchise. Bonus or premium payments are a per kWh subsidy appropriated in the state budget process.

Program Details:

- Approximately 160 MW have been installed under this program or 11 times the total installed wind capacity of Ontario.

- When the existing program is completed, some 200 MW of commercial wind generation will be in operating in Minnesota, all owned or partially owned by Minnesota farmers. This is two-thirds of Ontario's expected wind capacity in 2007 if all the contracts awarded are built.
- Currently, Minnesota's standard offer contract is only available through Xcel, the largest electric utility in the state.
- Xcel's Standard Offer Contracts run for twenty years.
- The program is limited to wind energy and targeted specifically at farmers.
- Minnesota also offers a small wind project incentive payment of US$0.015/kWh. The incentive is paid for ten years.
- Funds for the program are periodically appropriated by the state assembly and are part of the state's budgetary process.
- The program was initially limited to 100 MW, and project size was capped at 2 MW. After the first 100 MW was reached the limit was increased by another 100 MW.

Issues:

Minnesota's incentive payment program is being reconsidered this legislative session for several reasons:

- Its dependence on the state budget process breeds uncertainty. The state legislature is revisiting the small wind program because of budget shortfalls.
- Its project size limit (2MW) is too low for modern wind turbines.
- The program is limited only to wind energy.
- Importantly, the premium payment coupled with Xcel's fixed-tariff are insufficient to drive development without the $.018/kWh Federal Production Tax Credit. Thus, development follows the boom and bust cycles resulting from the federal tax program.

Netherlands

After many years with Standard Offer Contracts, the Netherlands recently introduced a program similar to Minnesota's. Whereas the Minnesota premium is limited to wind projects less than 2 MW, the Dutch premium is tailored to several different technologies.

Issues:

- The Dutch program has two fundamental flaws: premium payments are paid from a fund and not placed directly into the rate base, and the number of years the premium will be paid is determined, in the case of wind energy, by capacity factor. This has led to distortions in the market for wind turbines. As a result the Dutch are re-examining the German-French model of Standard Offer Contracts.

California

In California, funds for solar photovoltaic premiums are raised from electricity consumers through a Systems Benefits Charge.

Issues:

- Disbursement is the purview of the state assembly. Thus, the pool of funds is limited, not open ended, and the assembly periodically debates whether to continue disbursing the funds.
- This uncertainty has led to a boom and bust cycle in California's PV industry not unlike the boom and bust in the United States' wind industry as a result of the on-again, off-again Production Tax Credit.

Summary of Variable-Pricing Models

OSEA Recommendation

Empirical evidence strongly suggests that variable-pricing models should not be used.

Rationale

In summary, the variable-pricing models entail significant complications and shortcomings that would prevent the program from achieving clear objectives. In particular, variable priced models have the following issues:

- Benchmarks such as the spot market or avoided costs are not relevant for the Ontario market; spot is currently based on coal, which is to be phased out and avoided cost requires costly studies to produce theoretical estimates of the avoided costs, rather than the actual costs of desired new generation. These benchmarks do not reflect the true cost of new renewable electricity.
- Benchmarks such as the spot market are lower than the recent RFP, and are therefore insufficient to allow investment.
- Variable pricing does not provide a stable, predictable income stream that is sufficiently reliable that lenders will provide the debt needed to build capital-intensive projects.
- Tax credits or premium subsidies would need regular appropriations or parliamentary action, and so are ineffective for long-term contracts required.
- Furthermore, premiums or tax credits are often secured from legislative budgets, and not placed directly into the rate base. This puts the burden on the taxpayer rather than the ratepayer.
- Most tax credits/subsidies for capital-intensive projects like wind, small hydro, and biomass are typically not accessible/useful to the average citizen looking to invest in their local renewable energy project; they tend to favour high net worth investors (however, they can potentially be relevant for smaller solar applications).

6.2 Fixed-Price Contracts in the Rate Base

Fixed-price contracts, that is, contracts that do not vary with the spot market price or respond to fuel-price volatility, are the other key avenue for arriving at prices for renewable energy.

These provide the greatest stability for all interested parties: project developers, lenders, suppliers, the provincial government, and ratepayers. Fixed-price contracts provide the certainty needed for developers and lenders to accurately forecast cash flow and therefore make favourable investment decisions.

The simplest and most straightforward strategy for paying the cost of fixed-price contracts under the pilot program is to place the cost in the rate base (as will be done for the winning contracts under the renewable energy RFP). By doing so there is no need to continually monitor the funds being collected by Systems Benefits Charges or other means and match these funds with the pilot program's payments.

A number of fixed-price or minimum-price models in use are discussed below.

European Union

Sixteen of the 25 countries that are members of the European Union use some form of Standard Offer Contracts. Some 84% of all renewable energy capacity in the EU was installed in Germany, Spain, and Denmark as a result of Standard Offer Contracts providing minimum prices. Details vary from one country to the next. Programs in most of these countries exhibit the key traits of a fixed-price or Standard Offer Contracts: purchase power agreements (PPAs) or Standard Offer Contracts open to all parties, and guaranteed prices for a specific period of time. However, those countries with the greatest success at developing renewable energy have all incorporated the cost of the premium prices into the rate base. Portugal is credited as the first EU member state to implement a minimum price system using Standard Offer Contracts in 1988. Germany followed in 1991 with its electricity Feed-In law.

Germany

The best example of successful implementation of minimum price, Standard Offer Contracts has been in Germany. Since 1991 Germany has seen a steady increase in the penetration of renewable energy, mostly wind energy, but also small hydro, biomass and solar photovoltaics. Previously, costs of the German system were borne by electricity ratepayers in the regions where the renewable generator was located. This was believed to place an undue burden on those living in windy regions of the country and the law was changed in 2000. The new Renewable Energy Sources Act spread the cost of the renewable energy premium over all ratepayers in the country. This is

seen as a more equitable distribution of the costs since all German society benefits from the environmental attributes that renewable energy bring to the country. The new law also provided a "hardship" clause for energy intensive industries to opt out of paying the slight increase in electricity rates due to the program. Few industries have exercised this option to date.

Spain

Spain followed the German example in 1994 with a royal decree and has consistently supported its renewable energy development policy since then. The Spanish program is seen as part of a regional economic development initiative as well as a means for increasing renewable supply. As in the new German program, costs of the premium payments are spread across all electricity consumers.

France

France followed the new German model after experimenting with a tendering system that failed to produce the contracted capacity. The French adapted the German model to French conditions but did not incorporate the same number of technologies as that in Germany. As in Germany, costs of the program are paid by all ratepayers in France and not paid from tax revenues. Following introduction of the French system of Standard Offer Contracts, there was rapid increase in the number of applications for building permits. In the few years since the program has been in place, installations have exceeded total operating capacity of renewable energy developed under the previous tendering system.

Minnesota

The situation in Minnesota offers an interesting look into experience with variable priced versus fixed price contracts. Like Ontario, Minnesota has considered several policy proposals for fostering community wind development. Unlike Ontario, Minnesota has multi-year experience with its existing small development incentive. In North America, Minnesota is the only jurisdiction with experience using a standard offer contract for small renewable power projects since California's SO4 contracts of the 1980s.

Nevertheless, as discussed in the previous section on Variable-Priced mechanisms, there are significant issues with the current policies in Minnesota. As a result, Minnesota is now considering a number of fixed-price approaches.

Minnesota has an active and effective public interest community—the nearly 600 MW of wind development in the south-western corner of the state is due directly to intervention by state NGOs. In concert with farm groups and state legislators from farm districts they have proposed several new strategies for fostering community wind development:

Option 1: Minnesota Premium Payment

- NGOs have proposed 1,500 MW of community wind capacity over ten years, through a premium payment of $0.023 CAD/kWh in addition to a fixed tariff representing the avoided cost.
- As in the current program the incentive would be limited to projects up to 2 MW, but would now include single wind turbines greater than 2 MW.
- The program would be limited to Minnesota non-profits, non-taxable entities (municipalities), residents, businesses, or some combination.
- To ensure broad distribution of the benefits of this program, no single investor in a for-profit project would be allowed more than a 49% financial interest in a given project, and no 10 investors could collectively own more than 90% of any one project. Projects may be aggregated.
- The incentive payment would be limited to ten years and would be paid for through a Systems Benefits Charge on all ratepayers.
- The proposed cap was set high to avoid the hoarding of contracts that plagued the small wind program when it was first introduced.

Issues:

- Such a premium is only useful if the fixed-price contract is sufficiently high that the combination can drive development.
- Again, this premium is solely targeted at wind energy and does not include other renewable energy technologies.
- The ten-year contract length may be insufficient to ensure that farmers and community groups have an adequate return on investment during the 20-year life of a wind turbine.

Option 2: Minnesota Tax Credit

- The NGO community envisions a state wind energy tax credit for individuals, non-profits, school districts, and rural utilities.
- The premium payment and terms are similar to those of the previous example.
- Individuals would be eligible to make use of these tax credits in proportion to their ownership stake in the project with a cap of $4,400 per Minnesota taxpayer per year.
- Limits on program participation are similar to those for the premium payment.
- Creating a state tax credit circumvents the problems associated with the Federal Production Tax Credit which benefits only large institutions that have a high enough tax liability to use the credits.

Option 3: Minnesota Community Wind Tariff

The proposal gaining the most interest is a "Community Wind Tariff."

- A fixed price would apply to all load-serving entities (utility companies) in the state, not just the Xcel franchise.
- There are several complex provisions to adapt the tariff to the availability of the Federal Production Tax Credit, e.g. reducing the tariff if the user can take advantage of the tax credits, increasing it if they cannot.
- Another proposed variation is to fix the tariff as a percentage of retail prices. The tariffs would apply to all load-serving entities until such time as they fulfill their renewable energy obligations under the Minnesota Renewable Energy Objective.

Though the situation is fluid, there seems to be a preference among the NGO community and the Minnesota Department of Commerce's Energy Office to support a Community-Based Energy Development (C-BED) tariff with fixed-prices and standard contract terms.

Summary of Fixed-Price Models

OSEA Recommendation

Given the structure and needs of the Ontario market, it is recommended that the province employ fixed-price contracts for the Standard Offer Contracts pilot program.

Rationale

- Experience shows that the markets that have had the greatest growth in community-scale renewable energy have been those that have used fixed-price models.
- Fixed-price contracts provide developers with the certainty of revenues and cash flows required to justify investment. This is particularly important for community-scale projects, where the funds are likely coming from average citizens and farmers who cannot afford the risk of variable-pricing.
- This approach is consistent with the recent RFP process; for all intents and purposes, the successful bidders received fixed-price contracts (with a small portion adjusted for inflation).
- As with the projects in the recent RFP, the ability to secure financing is critical. Fixed-price contracts provide the reliability and stability that is necessary for lenders.
- The province has been emphasizing the importance of the true cost of electricity to the market; fixed-price contracts are designed to be reflective of the true cost of new renewable electricity generation.
- Fixed-price contracts, as envisioned by OSEA, will be placed in the ratepayer base, which is the most appropriate approach. In this way it does not burden the provincial budget or the taxpayer.

6.3 Standard Offer Prices in Europe & North America

The alternative pricing policies for Standard Offer Contracts vary around the world, in part due to the model in use, and in part due to the current energy, environment and costs. In all cases, however, the pricing for successful systems is sufficient to offer a reasonable expectation of profit and to attract investors.

Typical first-year prices for wind energy range from a low in Minnesota of $0.06 CAD/kWh to a high of $0.16 CAD/kWh in Portugal. These prices compare favourably to the total price for wind energy under Britain's Renewable Obligation Certificate trading system of about $0.14 CAD/kWh and much lower than the prices being paid in Italy under its ROC trading system of nearly $0.18 CAD/kWh (see Figure 4. First Year Fixed-Price Renewable Tariffs in $CAD/kWh).

First Year Fixed-Price Renewable Tariffs (in $CAD/kWh)

Country	Wind	Photovoltaics	Hydro	Biomass
Austria	$0.125			
California (proposed)		$0.667		
Czech Republic (proposed)				
Brazil	$0.095		$0.058	$0.063
France <12 MW	$0.135	$0.245		
Germany	$0.140	$0.923	$0.123	$0.185
Italy (proposed)		$0.804		
Minnesota*	$0.057			
Spain <50 MW	$0.106	$0.676	$0.106	$0.106
Portugal	$0.161	$0.458	$0.132	

*Xcel Fixed-price tariff plus Small Wind Project premium.

Figure 4:
First Year Fixed-Price Renewable Tariffs in $CAD/kWh.

7. Pilot Program Objectives

Based on the discussions with the Ministry of Energy and the various stakeholders in the process, the objectives for the proposed pilot program are:

1. **Broad participation** – The program should lower the barriers to entry to enable farmers, community groups, First Nations, co-operatives, rural businesses and industry, and others to profitably build small (up to ≈ 10MW) renewable power projects to serve Ontario's power needs.
2. **Stable market** – The pilot program should provide a stable market to allow steady development of the renewable energy industry in the province and attract renewable energy technology manufacturing.
3. **Replicability for Other Renewable Electricity Technologies** – Most experience with Standard Offer Contracts have been with wind energy and photovoltaics. However, the policy chosen should work equally well with other sources of renewably-generated electricity, such as that biogas or biomass plants, or that from small hydro plants (as it has worked in leading countries such as Germany).
4. **Simple, streamlined cost-effective process** – The process should facilitate project development by streamlining the issuance of contracts and interconnection agreements. The Standard Offer Contracts through the pilot program should cut transaction costs dramatically for both participants and the province over those used previously with the tendering system.

8. Eligible Renewable Technologies for Pilot Program

The scope of renewable technologies to be included in the program is a key component of the pilot design.

OSEA Recommendation

The pilot program should offer standard contracts with differential pricing for four technologies:

Rationale

- Ontario is capable of generating renewable energy from a range of technologies, and so it is beneficial to take advantage of all technologies.
- This is also prudent in terms of building supply diversity into the system.
- The effectiveness and benefits of the pilot will be enhanced based on greater learning across all technologies by deriving field experience with a host of technologies, not just wind energy.

9. Eligible Participants in the Pilot Program

The Ministry of Energy asked OSEA to propose a pilot program for community wind power development. Therefore, it is important to define the type of organizations eligible to participate in the pilot.

OSEA Recommendation

The pilot program should be inclusive, not exclusive. OSEA's definition of "community" is therefore expansive and includes farmers and rural landowners, community-based organizations, co-operatives, First Nations, NGOs, municipal entities, private individuals, small businesses and combinations thereof.

Furthermore, OSEA recommends that the "Orphaned" renewable generators — the existing small wind projects that were unable to participate in the recent RFP—be 'grandfathered' into the Standard Offer Contracts pilot program.

Rationale

- One of the pilot program's goals is to enable as broad participation as possible to unleash the full creativity of Ontario's people in meeting their needs for renewable sources of generation. A more inclusive approach will bring diverse players and strengthen the success of the pilot program.
- No program can anticipate all the possible combinations of private individuals, businesses, municipalities, NGOs and community groups that might arise from the availability of Standard Offer Contracts. Thus, the pilot program should be open to all participants.
- Maximum project size will effectively become a proxy for community-based, locally-owned, or distributed generation.
- OSEA's definition does not preclude profit-making enterprises. In fact, OSEA encourages for-profit ventures as this can stimulate community or local ownership of renewable power generation.

A partnership between a co-op and a municipality made this pioneering effort a success.

- These projects will likely come in many shapes and sizes, but are unified by having some level of local or public involvement, equity, initiation, and control. Examples include: school-owned wind turbines, farmer-owned wind co-operatives, Limited Liability Corporations (LLCs), and local public power (municipally owned in whole or part) wind projects.
- With respect to the 'Orphans', these projects were pioneers in renewable energy and made investments based on the government direction regarding the electricity marketplace at the time. The reversal by the government at the time left these projects without a marketplace for their power. Their viability was further compromised by not being allowed to participate in the recent RFP. It is imperative that the government redress this situation to demonstrate market integrity.
- The 'Orphan' projects are all of the scale being proposed for this pilot, so this is the logical and appropriate category for them; it is not reasonable to expect them to bid into the RFP against much larger projects using newer technology.

10. Pilot Program Contract Design

The scope and basic structure of the contracts for the pilot need to be defined.

OSEA Recommendation

- Price paid per kWh,
- How adjustments, if any, are made in the price,
- How often and when payments are issued,
- Length of the contract,
- Reporting requirements,
- Amount of time allowed from signing the contract and its activation,
- Consequences of not commencing operation within the time allotted,
- What happens when the term of the contract is reached,
- The process for dispute resolution,
- A periodic evaluation of how well the premiums are performing so the initiative remains on target.

Standard offer contracts must be simple, transparent and written in clear or what Donna Cansfield, MPP (Etobicoke-Centre), calls "Canadian Tire" language. Contracts need not be elaborate but need to state that the generator has the right to connect and be paid for their generation, and include:

Rationale

- To be as inclusive as possible, and accessible to all potential participants, it is essential that the contracts be comprehensive yet streamlined in nature.

- For these types of projects, a standardized, brief contract is the most appropriate and cost-effective approach. Extensive, complex legal documents would create undue burden and costs on potential participants and would consequently deter participation.
- Similarly, the cost for the province to administer contracts needs to be cost-effective and in proportion to the value of these types of projects.

11. Pilot Program Standard Offer Contract Term

One of the most critical elements for success in the pilot is the contract term.

OSEA Recommendation

OSEA recommends 20-year contracts for the pilot projects.

There should also be some provision to allow extension of the contract at the end of the contract's term or to allow switching the contract to the spot market price, average system price, or system avoided cost without a rate proceeding before the OPA or OEB.

Rationale

- To encourage investment, developers need reliable, long-term price commitments.
- With the prices proposed, 20-year contracts should allow sufficient time to amortize the investment and earn a reasonable rate of return on the invested capital as well as return sufficient benefits to provincial ratepayers.
- This proposed term is consistent with the term for contracts awarded under the recent renewable energy RFP, so there is alignment from a process perspective.

Most jurisdictions that have used Standard Offer Contracts like those in the pilot program have chosen 20-year terms. Early Danish and German Standard Offer Contracts were open ended, that is, there were no time limits on payments under the contract. California's SO4 contracts were 20 to 30 years in length with most choosing 30-year contracts that included a 10-year fixed-price portion followed by 20 years with variable tariffs depending upon a determination of avoided cost. German contracts are for 20 years, French contracts for 15 years, and Spanish contracts include provisions for more than 25 years depending upon the technology and up to the full operating life of the renewable generator (see figure 5: Typical Contract Term in Years).

Typical Contract Term for Renewable Tariffs (in years)

Country	Wind	PV	Hydro	Biomass
Austria	13			
California (proposed)		3		
Czech Republic (proposed)	15			
Brazil	20		20	20
France	15	15		
Germany	20	20	15-30	20
Italy (proposed)		29		
Minnesota*	20			
Spain	>15	>25	>25	>20
Portugal	12	12	12	

*Xcel Fixed-price

***Figure 5**: Typical Contract Term in Years*

12. Pilot Program Project Size Limit

The Ministry of Energy asked OSEA to consider the limit that should be implemented on the size of individual projects eligible for the pilot.

OSEA Recommendation

Based on the program objectives, OSEA recommends that:

- The pilot program is limited to distribution voltages of 44 kV or less and that projects are limited to approximately 10 MW.
- The 10 MW project size limit should include the last turbine in, that is, if the last turbine added pushes the total over 10 MW, it is included. Thus if there were five 1.8 MW turbines, the sixth could be added even though it would increase the project size to 10.8 MW. Similarly, if there were three 3 MW turbines the fourth turbine could be added, bringing the project total to 12 MW.
- The amount of capacity that qualifies under the pilot program will be determined at the point of interconnection. That is, each 10 MW project must have its own interconnection to qualify for the pilot program.
- The 10 MW limit should be revisited during the two-year review of the pilot program described later. This limit, and whether it is too low to capture all the benefits of distributed generation, can be one of the conditions specifically examined during the review.
- OSEA suggests the distribution voltage requirement for northern Ontario and First Nation communities be further investigated to ensure they are not unnecessarily excluded.

Rationale

Throughout 2004 OSEA proposed Standard Offer Contracts for projects less than 10 MW in size. For OSEA, this size acted as a surrogate for small, locally-directed wind projects that could take full advantage of the benefits that distributed renewable generation can provide. We believe this remains true today. Other considerations include:

- To maximize the benefits of distributed generation, projects must be connected to distribution voltages of 44 kV or less.
- The Independent Market Operator considers projects less than 10 MW embedded generation and doesn't need to register with the Independent Market Operator (IMO). Limiting project size to less than 10 MW also simplifies settlement procedures with Hydro One or Local Distribution Companies (LDCs).
- Nevertheless, a project size cap of 10 MW will restrict local developers with the capability of building projects of 20 MW or more and who have the acumen needed to apply for an IMO generator license. Public opinion surveys for Sustainable Energy Ireland, a state-funded agency, found that acceptance

of wind energy was greatest when projects were limited to clusters of no more than ten turbines. With today's 3MW wind turbines this is equivalent to projects of 30 MW.

- Further, a 10 MW limit may be too small to capture all distributed biomass technology and some hydro projects, but it will capture all solar photovoltaic projects.
- While an initial 10 MW project limit may be too low in light of today's multi-megawatt wind turbines and some hydro projects, the review period can allow for this to be revisited and remedied if necessary. However, the review should consider *only* whether the limit should be raised, not lowered. One of the objectives of the pilot program is to demonstrate a stable domestic market to the renewable energy industry (developers, lenders, and suppliers). For this objective to be met, suppliers need assurance that the program will not be reduced during the pilot period so that they can plan their investments in technology and human resources accordingly.

13. Overall Project Limits for the Pilot Program

Another aspect of the program design to be considered was the requirement for an overall program limit to the amount of renewable power contracted under the pilot program. There is a concern that an untested — at least in Ontario — pilot program might be far more successful than anticipated, resulting in an excessive amount of new renewable generation. The natural response to this concern is to set limits or caps on the program's ultimate size.

OSEA Recommendation

Self-Limiting: No Cap
OSEA believes that there must not be a cap for the pilot program. The very nature of these projects (less than 10 MW, on distribution feeders) is self-limiting, and so a cap is unnecessary.

Program Time Limit Cap
However, if the concern remains that the pilot program may result in excessive capacity and the province wishes to manage the pace of development, the province can do so very simply by limiting the pilot program's length. In this case, OSEA strongly recommends that the program be limited by a time period, rather than a cap of the power contracted.

It is suggested that the pilot program be established to expire in 2010 with discussions on renewal, extension, or changes to the pilot program to begin in 2009 to allow ample time for evaluating the program.

To clarify, the opportunity for new contracts under the pilot program would expire on this date, contracts implemented in 2010 would run a 20-year course if the contract term was determined to be 20 years.

Other Options Considered

1,000 MW Cap

- Limit total program size to about one-third of total renewable capacity planned under the government's commitments of 2,700 MW by 2007.
- This is roughly equivalent to 1,000 MW of nameplate capacity, possibly more if the lower capacity factor of renewable energy is fully taken into account.

400+ MW Cap

- Limit total program size to that already awarded in the first renewable RFP. This would be equitable to individuals and community groups as well as small developers who were prevented from participating in the first RFP.
- The cap would be lifted by an equivalent amount to reflect subsequent renewable RFPs.

Rationale

- The term of the pilot program must be long enough to allow ample opportunity for participation and for a meaningful amount of capacity to be installed to gauge the program's success.
- Whereas the previous prospects of market deregulation and subsequent announcement of RFPs provided large players of the private sector with signals to encourage investment in development activities, these signals have not been in place for community-scale projects. Appropriate time must be factored in to allow these projects to ramp up development. A minimum of five years would be necessary for this, setting the expiration of the program at year-end in 2010.
- The existing RFP process for larger projects was established to ensure the province meets their stated renewable energy targets. Since this is a pilot program, it is important to test and evaluate it outside the parameters of the primary program.
- Caps or artificial limits to program size invariably leads to gaming and a rush for contracts before the limits are reached.
- Caps lead to uncertainty among participants about the availability of contracts. One of the purposes of the pilot program is to provide certainty so that a broader and more representative cross section of Ontario's economy can participate in renewable energy development. Uncertainty regarding the availability of contracts inhibits project development because it becomes unclear if the up-front development expenses will be recovered with a contract.
- The proposed duration of the pilot is consistent with the overall provincial goals for renewable energy.

- While most existing standard offer contract programs are limited, Germany's is open-ended, that is, there is no limit on the amount of renewable energy that can be built. Germany is effectively striving for 50% renewable penetration by 2050.
- Spain's limit on wind energy is so high (13,000 MW) that it is effectively open ended as well.
- Note that Denmark has met its goal of 20% of electricity *generation* — not a percentage of capacity as in Ontario--and this has become a defacto limit (see Figure 6: Program Size Limits).

Standard Offer Contracts
Program Size Limits

Country	Wind	Solar	Small Hydro	Biomass
Germany	No limits	No limits	No limits	No limits
Spain	13,000 MW	150 MW	2,400 MW	3,200 MW
Denmark	20%*			
France	1,500 MW			
Brazil	1,100 MW			
Minnesota	200 MW			
Austria		15 MW		

* percent of actual kWh generation, not capacity

Figure 6:
Program Size Limits

14. Standard Offer Contract Pricing

There is mounting evidence that renewable energy tendering systems can result in higher prices than those prescribed in Standard Offer Contracts.

A recent study produced by the Cambridge – MIT Institute reaffirms numerous other papers comparing tendering mechanisms with Standard Offer Contracts to support wind power development. The paper concludes that tendering systems may not result in the contracted capacity and can result in higher cost than Standard Offer Contracts.

Data on prices in Germany and Great Britain "…does suggest that the price paid for wind energy is already lower in Germany than in the UK, and that this is likely to remain the case over the medium term."

Moreover, the price bid under such tendering systems may not be representative of true costs because so little of contracted capacity is built. "It is thus questionable whether a competitive tendering process, which places such emphasis on reductions on the price paid for wind energy, is the most appropriate means of encouraging an expansion in capacity", say the authors.

The study concludes that the oft-stated reason for Britain's poor installation rate of wind energy due to planning hurdles was incorrect and to the contrary the reason was an insufficient price to pay for profitable projects.

At the core of the Standard Offer Contracts program is the pricing mechanism. As discussed in the Background section, fixed-price contracts are superior to other pricing mechanisms in terms of driving development in community-scale renewable energy.

Some may question whether it is possible to find an appropriate price for fixed-price contracts outside the price-setting function of a marketplace. However, prices for Ontario electricity generation have been set politically by the province for many years. Prices for renewable generation have been determined in many other jurisdictions with great success. Approximately 2/3 of the world's wind capacity has been created in markets with fixed price mechanisms; there is no

reason why Ontario can't emulate the success of Germany, France, Spain, and others. Fixed prices are appropriate for renewable energy, and have been clearly proven to generate strong results.

14.1 Pricing Summary

OSEA Recommendation

OSEA recommends a fixed price approach for the various renewable technologies under consideration.

Figure 7:
OSEA Proposed Specific Prices

OSEA Proposed Renewable Standard Offer Prices

	Years	Yield kWh/m2/yr	Specific Price* $CAD/kWh	Avg. Blended Price 20 yrs. $CAD/kWh	Net Present Value 20 yrs. $CAD/kWh
Wind**					
High Wind (<1,100kWh/m2/yr)	6-20	1100	0.069	0.091	0.047
Medium Wind (<900kWh/m2/yr)	6-20	900	0.090	0.105	0.054
Base Wind (<650kWh/m2/yr)	6-20	650	0.133	0.133	0.066
All	1-5		0.133		
Solar Photovoltaics					
Commercial Loans	1-20		0.83		0.414
With Soft Loans	1-20		0.67		0.518
Small Hydro	1-20		0.133		0.066
Biomass	1-20		0.133		0.066

* Adjusted 15% for inflation.
** Linear interpolation between Base, Medium, & High Wind.

Figure 7: provides a summary of the overall prices proposed. More detailed analysis of the pricing for individual technologies follows.

All prices are indexed at 15% for inflation, to match the RFP. Experience and further research may show that a higher rate of indexing is required for smaller projects (10MW and under). Nevertheless, the NPV over the 20-year period is significantly lower because of the cost of capital for alternative investments (see Figures 8-10).

Rationale

- Two strategies for pricing were considered: a percentage of the retail price as in the original German feed law and as is used today in Spain, or fixed prices. The former is not appropriate for Ontario because of past provincial actions forcing the retail price below the cost of generation, and the prior tendency of parties to set the retail price for political reasons. Since one of the pilot program's principal objectives is to provide stability and certainty in pricing, past provincial action capping or cutting the retail price of electricity obviates a retail based price system.
- Picking the percentage of the retail rate that reflects a price sufficient to drive development is not much different than determining a price in the first place. If the price is pegged to the retail rate this negates the benefits of a fixed-price system to ratepayers. As retail rates rise over time, so do prices reflecting a percentage of the retail rate. Retail electricity rates can rise faster than inflation if fuel prices increase dramatically and a significant portion of the generation mix is dependent upon fossil fuels.
- The actual prices were based on industry assumptions that were input into the economic models presented by Bernard

Chabot at the pricing workshop. These details are discussed below in the Pricing Assumptions section.

- There is no evidence that an RFP process results in the development of more "higher-quality assets" than that developed by fixed-price contracts. There are some projects with poor technical and financial performance in either system.
- Fixed-prices, such as those proposed in the pilot program, provide opportunity to more participants than the RFP process, leading to many small projects. Lenders to small projects require higher debt-coverage ratios, and more conservative balance sheets than that typically required of large projects. Fixed-price contracts can therefore be expected to result in more "higher-quality assets" rather than less.

14.2 Pricing Workshop

As part of co-ordinating contract design, OSEA organized a two-day workshop with internationally-renowned renewable energy economist Bernard Chabot. France's national energy management agency, ADEME (Agence de l'Environnement et de la Maitrise de l'Energie), kindly donated Mr. Chabot's assistance in designing specific tariffs for renewable energy in Ontario. Mr. Chabot is the architect of France's Advanced Renewable Tariffs that have resulted in more than 330 MW of wind projects being constructed in the past four years--all less than 12 MW in size. 24 people participated in the price-setting workshop held January 10-11, 2005 in Toronto.

14.3 Pricing Assumptions

A number of techniques and assumptions went into the determination of the prices:

- Chabot's pricing model uses the Profitability Index (PI) Method. While simple, the model is sufficiently robust that banks, utilities, and other large institutions use it to weigh investment decisions. Results from Chabot's Profitability Index Method show strong predictability correlations when compared with the prices paid in the German system that were derived from cash-flow models.
- Chabot's model calculates prices needed to meet target profitability before taxes. OSEA's calculations for wind energy assume no subsidies in the form the Wind Power Production Incentive.
- The Profitability Index is the ratio between the Net Present Value (NPV) of an investment and its initial cost. The NPV uses the average weighted cost of capital (nominal 8.2%), accounting for both the interest on debt (6.9%) and the desired rate of return on equity (13%). Chabot illustrated that in practice the Optimal Rule of PI is 0.3.
- There is very little actual experience with wind energy in Ontario. There is only 15 MW operating in the entire province.

A Note on Net Present Value of Fixed Prices

Most renewable technologies are capital-intensive with low or zero fuel costs. In this regard they more closely resemble large hydro power plants than fossil fuel-fired generators with their variable — and rising — fuel costs. As a consequence, the costs of electricity from long-lived, capital-intensive technologies, such as wind and solar energy, must be considered over periods of twenty years or more. Thus it is necessary to include the time-value of money in any discussion of the costs of electricity from Standard Offer Contracts for renewable sources of energy. One means for doing so is to use the Net Present Value of payments over the term of the fixed-price contract.

Net Present Value accounts for the effects of inflation and the cost of capital. The Net Present Value of a payment stream over time is less than the face value of the initial or year-one payment.

When discussing the cost of Standard Offer Contracts it is incorrect, and in fact misleading, to use the initial or year-one price as this does not reflect the true costs over time. It is more accurate to use the Net Present Value to reflect the cost of Standard Offer Contracts over time than to use the initial price.

Consider for example a fixed-price tariff of $0.10/kWh for 20 years with no adjustment for inflation. The Net Present Value is ~$0.05/kWh — depending upon the assumptions used — or about one-half that of the initial price in year one. This example conveys the importance of accounting for the future costs of generation from both fixed-cost, capital-intensive technologies, and from variable cost technologies dependent upon the future price of fossil fuels.

Even when prices are indexed with inflation, the Net Present Value of prices under Standard Offer

continued on page 38

continued from page 37

Contracts are less than the year-one or initial price because the Net Present Value uses the nominal weighted cost of capital. Many analysts estimate that the cost of fossil fuels will increase at a rate greater than inflation during the next two decades. Even if Standard Offer Contract prices are fully indexed with inflation, these price increases will likely lag price increases for fossil fuels from increasing scarcity. Thus, fully or partially inflation indexed prices of renewable resources should offer an attractive advantage relative to the increasing cost of electricity from fossil fuels, especially natural gas.

With so little experience it is difficult to project installed costs with strong certainty. OSEA found a wide range of costs for installing commercial wind turbines in the province. OSEA chose to use a 1.5 MW wind turbine as a proxy for calculating installed costs relative to the area swept by the wind turbine rotor. Defining installed cost in these units makes redundant the different rating systems used by different manufacturers of wind turbines and is more directly related with annual specific yields than costs in dollars per kW of generator capacity. OSEA assumed an installed cost of $675 CAD/m2 as representative based on data from an OSEA member organization.

- The model in this report assumes that 15% of prices are adjusted for inflation to match the RFP. However, Chabot recommends fully adjusting prices for inflation and in France prices are indexed at 60%.
- As in the German and French programs, OSEA proposes using the same initial price during the first five years of operation for all wind projects less than a nominal 10 MW at 44 kV or less.

14.4 Wind Power Prices

OSEA Recommendation

For wind, OSEA recommends a pricing mechanism that provides differential pricing based on productivity or specific yield. Annual specific yield in kWh per square meter of rotor-swept area (kWh/m^2/yr) is the wind industry's standard measure of productivity.

All wind projects will receive the same price for the first five years and in years 6-20 the medium wind and high wind sites will receive proportionally lower prices.

- In years 1-5 of the contract, the price would be $0.133 CAD/kWh
- In years 6-20, the price would depend on the actual yield observed in years 1-5
  - o For base wind: $0.133 CAD/kWh
  - o For medium wind: $0.09 CAD/kWh
  - o For high wind: $0.069 CAD/kWh

Example:

A wind turbine on the shore of Lake Huron at an optimum site for Ontario with a productivity of 1,100 kWh/m^2/yr will be paid $0.133CAD/kWh for years 1-5 and $0.069 CAD/kWh for years 6-20. The *average* price (average of all 20 years) equates to $0.091 CAD/kWh. Significantly, this is only $0.01 CAD/kWh more than the average bid price in the province's renewable RFP. The *net present value* of this price is $0.047 CAD/kWh after accounting for both inflation and the cost of capital during the 20-year contract life.

Fixed Price (as Opposed to Variable or Spot-Market Price) Adjustments for Inflation

	Inflation Adjustment as Percentage of CPI
Germany	0%
Ontario RFP	15%
France	60%
OSEA Proposed	15% (to be evaluated, may need to be increased)
California ISO4, EPO1	Fixed Forecasted 10-year Avoided Cost
California ISO4, EPO2	Fixed Forecasted Levelized 10-year Avoided Cost
California ISO4, EPO3	Fixed Forecasted Incremental Energy Rates from then Current Oil & Gas Costs
California FSO4	Ramped for Inflation

*ISO4: Interim Standard Offer Contract 4 (New Contracts Suspended 1985).
**FSO4: Final Standard Offer Contract (Never Implemented).

The actual price in years 6-20 would be a linear interpolation between the three tranches; that is, a site that falls between a medium wind and a high wind site will be paid according to where the annual yield falls relative to the medium and high wind yields.

Specific details of the pricing mechanism:

- For the first five years of operation all wind turbines receive the same price.
- In the sixth year, the average of the first five years of operation is determined after removing the highest and lowest year of generation.
- The resulting average annual specific yield is compared to a linear interpolation between the values shown in the accompanying figure (see Figure 7 below).
- An energetic site with a well performing wind turbine generating more than 1,100 kWh/m^2/yr will receive payment of $0.069 CAD/kWh in year 6, but no less.
- A wind turbine delivering less than 650 kWh/m^2/yr will receive $0.133 CAD/kWh in year 6, but no more.
- Between these values, the price will vary linearly with annual specific yield.

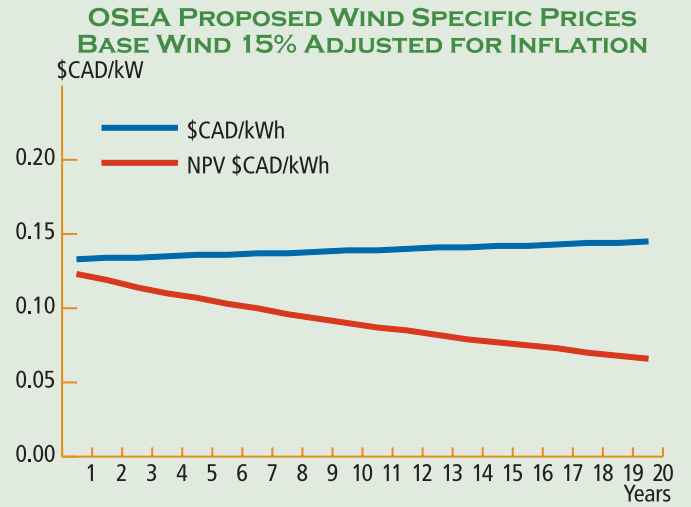


Figure 8: *OSEA Proposed Specific Prices BAse Wind.*

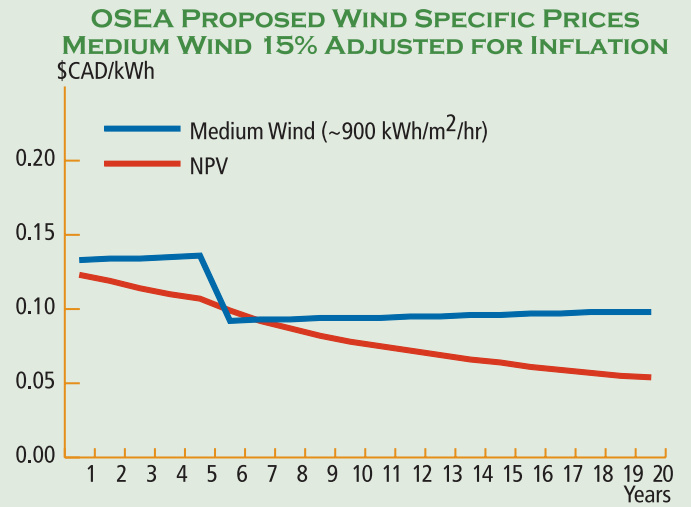


Figure 9: *OSEA Proposed Specific Prices Medium Wind.*

Rationale

Three Tranches for Wind Energy

- OSEA proposes three tranches for sites representative of base wind, medium wind, and high wind. This approach ensures that wind power is distributed across the province, rather than being concentrated in a few high-wind locales.
- Some have argued that fixed prices through Standard Offer Contracts do not provide economic efficiency, because the contracts are available to all. Despite the fixed prices in a series of tranches, economic efficiency is encouraged in the pilot program as explained below.
- As productivity or specific yield increases, so too does profit, providing an incentive to use the most energetic resources first, creating competition for the most productive sites. Lowering prices in years five through twenty does limit maximum profitability but doesn't limit the total amount of profits; allowing much higher profits than that relative to areas with weaker

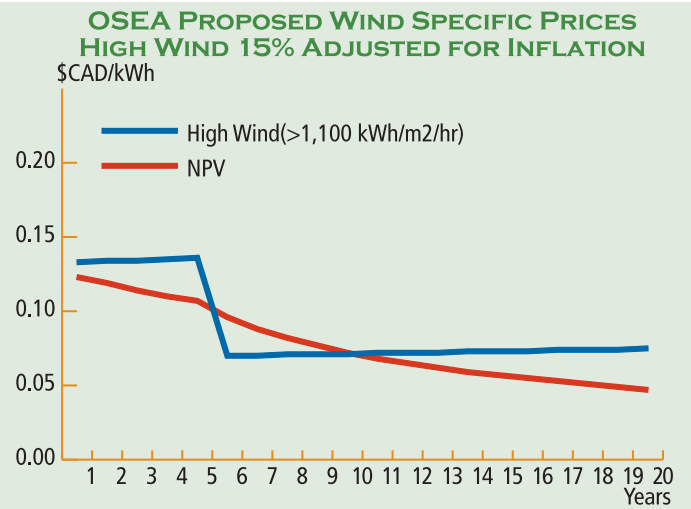


Figure 10: *OSEA Proposed Specific Prices High Wind.*

Equivalent Wind Speed for Annual Specific Yield at Hub Height

Yield kWh/m2/yr	Wind Speed m/s
650	~5.6
900	~6.44
1100	~7.05

Rayleigh Distribution

wind resources. So while the pricing model is designed to provide the minimum profitability to stimulate wind development at feasible locations throughout the province, it simultaneously rewards economic efficiency.

- Though the first-year price per kWh may be higher than bid prices for windy locales, the cost risk to the province is minor. Development risk is borne entirely by the project proponent, not the province. If the site has lower productivity than that needed for a profitable venture, the risk falls entirely on the equity and debt holders of the venture. The province, because it only pays a per kWh price, pays only for actual generation. When production is low, so are total payments.

Reference Points for Wind Energy Prices

One of the challenges in establishing prices is the consideration of the different levels of productivity and output from different turbine models and different wind regimes:

- Both the German and French systems adjust prices for wind energy as a function of the productivity of a specific wind turbine at a specific site from its actual average generation.
- The German model uses a series of reference wind turbines and compares actual average generation to the reference turbines. This is relatively simple in Germany where the wind resource is well known and there are numerous research centers and test sites with data on wind turbine performance in the field.
- The French model opted for an alternative strategy because wind data and data on performance of wind turbines in France are not as extensive as in Germany. The French model compares site productivity in full-load hours (the European equivalent of capacity factor) to Chabot's reference profitability targets.
- Reliance on wind turbine generator rating and the resulting capacity factor is always dangerously misleading as there are no international standard ratings for wind turbines. Consequently, manufacturers can game any system using capacity factors or full-load hours by "rating" or identifying their wind turbine with the generator size that serves their marketing needs best. The French have quickly realized this problem, as have the Dutch.

Annual Specific Yield

- Chabot's proposal for Irish Standard Offer Contracts uses annual specific yield instead of capacity factor to correct the problem. Annual specific yield in kWh per square meter of rotor-swept area (kWh/m^2/yr) is the wind industry's standard measure of productivity.
- OSEA has chosen to use annual specific yield for wind energy Standard Offer Contracts in Ontario.

- OSEA targeted a Profitability Index of 0.35 for sites with average annual specific yields of 1,100 kWh/m^2. This is probably the optimum yield that can be expected from sites in southern Ontario.
- At low yield sites, profitability will be much less. This encourages economic efficiency by directing development toward windier sites first. The Profitability Index for the low wind targeted yield of 650 kWh/m^2/yr is only 0.1.

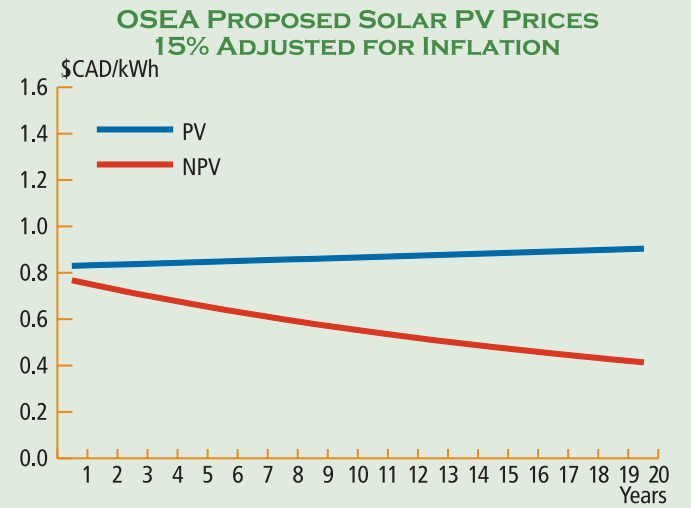


Figure 11: *OSEA Proposed Solar PV Tariffs for Ontario with Commercial Loans.*

Ensuring Responsible Profit Opportunities

One of the misperceptions with fixed price programs is that the system could be manipulated to generate unfair or excessive profits, at the expense of the ratepayer. In fact, the very nature of the pricing model proposed ensures that the prices are derived based on reasonable profit assumptions to start with. By basing the model on actual yield, reasonable profit levels are automatically entrenched in the process. Furthermore, the process of removing the high and low years from the five-year evaluation point ensures that developers cannot game the system.

As noted previously, the pricing model also encourages good planning and economic efficiency. While minimum acceptable profit levels will encourage more widely distributed generation across the province, there is still sufficient incentive to encourage the development of the most economically feasible sites first.

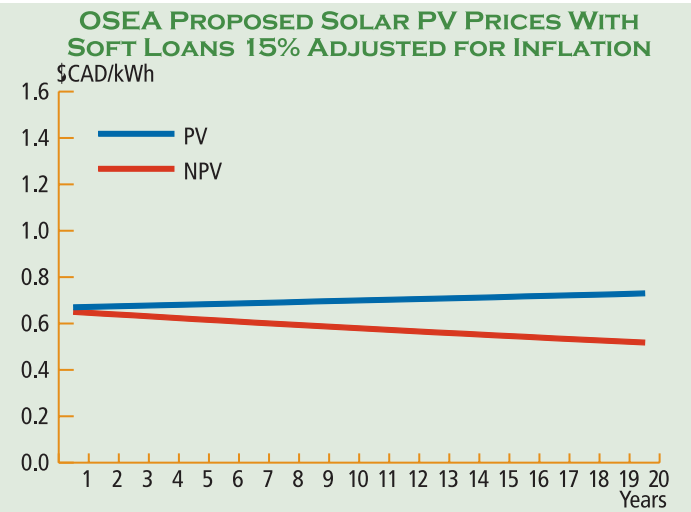


Figure 12: *OSEA Proposed Solar PV Tariffs for Ontario with Soft Loans.*

14.5 Solar Prices

OSEA Recommendation

OSEA considered two cases; commercial loans and soft or low-interest loans (see Figure 11-12):

- With commercial loans, OSEA recommends a price of $0.83 CAD/kWh for the 20 year duration of the contract
- For soft or low interest loans, the recommended price is $0.67 CAD/kWh for 20 years.

OSEA does not recommend any differentiation in pricing by size of installation at this time.

Rationale

- The prices selected were based on the results of the modeling exercise at the Chabot workshop.
- In Germany and Spain, Standard Offer Contracts for solar photovoltaics are differentiated by project size. In these programs roof top installations, typically less than 5 kW, are paid one price, large central station plants a lower price. For exam-

ple, in Spain, installations less than 100 kW are paid 575% of the retail rate (about $0.68 CAD/kWh) for the first 25 years of operation. Larger systems are paid less. Projects greater than 100 kW are paid 300% of the retail price, or $0.35 CAD/kWh.

- There is so little experience with grid connected solar photovoltaics in Canada that it is not warranted to differentiate prices by project size. OSEA polled the Canadian Solar Industries Association (CanSIA) for the cost of a typical roof top installation. While the industry suggests it can install 3 kW roof top photovoltaic systems for $7,000 CAD/kW, this estimate does not conform to experience in California or elsewhere, nor with the experience of installers in Ontario.
- OSEA chose an installed cost of $10,000 CAD/kW with an annual generation of 1,400 kWh/kW of installed capacity – typical of Ottawa.

14.6 Small Hydro & Biomass Prices

OSEA Recommendation

OSEA proposes using the first-year price for wind projects as a place holder for small hydro and biomass plants of $0.133 CAD/kWh.

Rationale

OSEA has focused its expertise on wind power rather than small hydro and biomass plants. OSEA coordinated our workshop with representatives from the agricultural biomass community and we attempted to find data on small hydro. One of the participants in the Chabot pricing workshop represented Keller Engineering Associates of Ottawa, designers of small biogas plants for dairy operations. They analyzed the production data are from an anaerobic digester in Cobden, Ontario, operating on a dairy farm with 140 milking cows. Capital cost and operating expenses are based on the experience in Cobden. Keller Engineering assumed:

- financing: 100 % credit (farm credit), no equity from the farmer required,
- the biogas engine is using 10% diesel fuel and 90% biogas (Schnell Germany, Bi-fuel piston engine),
- only biogas production with manure (no Co-Substrates),
- no value is given to heat production (some can be used for heating the residential house),
- no taxes,
- straight line pay-back with interest (annuity), and a
- profitability index 0.1, because the farmer has other, non monetary, advantages from the system such as odour reduction and improved fertilizer quality.

Keller Engineering, using the Chabot method, found that a 20-year contract with an initial price of $0.131 CAD/kWh would be necessary for limited profitability.

15. Federal Wind Power Production Incentive

OSEA suggests there are two reasonable alternatives with respect to how the Federal Wind Power Production Incentive (WPPI) is factored into the pilot pricing.

OSEA Recommendation

In general, OSEA recommends that WPPI not be included in any price determination. This can be achieved in two ways.

One policy option is for the Ministry to require that all projects participating in the pilot program apply for WPPI payments if they qualify. At the end of each year for which a project receives WPPI payments, the proponent should provide a report to the province indicating what funds were received under the WPPI program. The province would then reduce their payment rate in the following year by the WPPI subsidy for the equivalent volume of power purchased, less a mutually agreed upon fee. In this way a $/kWh rate can be calculated for the next WPPI reporting period. The fee is to recognize the services of the project owner in administering the WPPI application and reporting process.

Another policy option is for the standard offer contract price to be reduced by the amount of the WPPI payment, a so-called claw back. However, the standard offer contract price would return to the appropriate value, indexed for inflation that would have been paid had WPPI not been available, once the WPPI payment expires at the end of ten years.

Rationale

- WPPI is a federal program over which the province has no direct control and consequently cannot predict future direction and outcomes and how they affect Ontario projects.
- Funding under WPPI is uncertain. Previously, Ontario's allocation of the federal WPPI subsidies was fully booked following the Ministry's renewable RFP. The federal Liberal Party recently increased the funding in the Federal Budget, but has no control over the future requirements required to support Ontario's growth potential.
- There are onerous restrictions in the WPPI program that restrict the province's ability to act. If the price paid under the pilot program is more than $0.14 CAD/kW for projects less than 5 MW, $0.12 CAD/kWh for projects 5 MW to 10 MW, or $0.10 CAD/kWh for projects greater than 10 MW, the federal government will either stop paying WPPI, or they reserve the right to demand repayment of WPPI.
- An equally important consideration is that WPPI only applies to wind energy. Small hydro, biomass and solar do not receive a similar incentive; therefore the playing field for the pilot program needs to be levelled.

Discouraging Gaming and Speculation

Historically, programs have been most susceptible to gaming when caps or limits were placed on program capacity or the time allowed to enter contracts was too limited. This was the experience with California's SO4 contracts and Minnesota's first community wind premium. Limiting program size or duration often leads to a "rush" for contracts.

There are a number of means for allocating contracts, for example by eliminating program caps, requiring a degree of local ownership or completion of certain project milestones.

Removing the Cause – Eliminating Program Caps

As stated, the simplest and most effective means for avoiding a rush for contracts or a hoarding of contracts is to ensure that the pilot program is sufficiently large or of a long enough duration that everyone who wishes to participate believes they will have an opportunity to enter a contract when they are ready.

Local Ownership Requirements

Qualification for contracts under the pilot program could be limited to projects with some certain minimum of local ownership. The Danish wind turbine co-operative movement was born out of such limitations in the Danish standard offer contract program. Initially to qualify equity owners of a wind turbine had to live in the county where the wind turbine was located. Later this was expanded to include residents of neighbouring counties. Even this requirement was successfully "gamed" toward the end of the program by residents of Copenhagen "buying" small plots of land in a farmer's field on the west coast of Jutland, in effect becoming a "resident" of the area and qualifying for the standard offer contract. Though the city

- WPPI is only paid for ten years, and not the full twenty years of the pilot program contract; thus WPPI cannot be relied upon to make up the price differential required for the duration of renewable energy projects.

16. Application Process & Awarding of Contracts

As mentioned previously, the pilot requires a simple and streamlined process for the application and awarding of contracts. Guidelines are required to ensure contracts are accessible and to discourage unfair practices by speculators.

16.1 Application for Contracts

OSEA Recommendation

At a minimum an application for a contract should contain the:

- Name of the project,
- Name of proponent,
- Feeder location and size,
- Evidence of site control,
- Size of project, and
- Technology employed (wind, hydro, solar, biomass).

16.2 Allocation of Contracts

OSEA Recommendation

Contracts would be awarded on a first come, first served basis to all those who can demonstrate site control. The contracts will be issued within 90 days of filing an application with the Ministry of Energy.

Contracts would be awarded to all eligible participants as defined earlier, which include farmers, other rural landowners, First Nations, community groups, co-operatives, businesses, municipalities, NGOs and combinations thereof.

The simplest and most effective means for avoiding a rush for contracts or a hoarding of contracts is to ensure that the pilot program is sufficiently large or of a long enough duration that everyone who wishes to participate believes they will have an opportunity to enter a contract when they are ready. OSEA suggests the pilot program run for a minimum of five years to reassure farmers and others that there is ample time for thorough pre-project planning and evaluation.

Other mechanisms that may be considered in terms of discouraging speculation are highlighted in the sidebar *Discouraging Gaming and Speculation*.

Rationale

- The first come, first served process is fair
- Site control ensures that the proponent has arranged the proper site agreements with the landowner to permit development.

- As mentioned previously, the pilot program should be inclusive not exclusive. One of the pilot program's key goals is to enable as broad access as possible. Thus, the pilot program should be open to all potential participants.
- Nevertheless, the pilot program is intended to help local landowners and organizations participate in the province's call for new power generation and it may be necessary to find mechanisms that discourage gaming or manipulation of the program to other ends.

17. Interconnection

A cornerstone of Standard Offer Contracts is the right to connect to the grid. OSEA has provided a number of recommendations in this regard.

OSEA Recommendation

All participants in the pilot program must have the right of interconnection with simple and transparent contract terms. A number of related terms must be included with this right.

Response Time to Request for Interconnection
Requests for interconnection to Hydro or Local Distribution Companies (LDCs) should receive a response within 90 days detailing technical requirements, equipment needed and any other conditions reasonably deemed necessary.

Transparent Process
The interconnection process must be transparent and orderly. Interested parties need to be aware of where their application sits relative to others in the area and the application process must be managed in an orderly fashion.

Costs of Interconnection
Direct costs associated with interconnection, including cabling and/or burial of underground feeders to the nearest interconnection, transformers and metering should be paid by the developer.

Costs of Network Upgrades
A key advantage of the proposed pilot projects is that they will generally avoid the major transmission issues facing larger projects. Since they are connecting to the distribution system there are fewer potential network upgrade issues. Nevertheless, if these are required, it is proposed that all costs associated with network upgrades be borne by the system and placed in the rate base and not placed on developers under the pilot program.

Rationale

- The province has determined that renewable energy technologies are a valuable addition (cleaner air and reliability of supply) to the generating mix. These benefits should be reflected by giving priority connection to distributed renewable energy projects.

resident legally "owned" the small plot of land just big enough for the wind turbine, the plot was managed as before by the rural landowner.

Maximum Limits on Total Ownership

To avoid hoarding or concentration of the Standard Offer Contracts in the hands of speculators, contracts could be limited to a maximum number of megawatts for each equity owner prorated on their ownership in each project. Alternatively contracts could be limited to a maximum number of megawatts awarded per year. One suggestion was to limit the maximum number of contracts to 20 MW per proponent per year. These are policy suggestions, not recommendations. ***OSEA has no position on ownership restrictions so long as sufficient contracts are available for all farmers, First Nations, co-operatives and community groups who want them.***

Expiration of Unexecuted Contracts

Another means for discouraging speculation is to limit the amount of time a project developer has to complete a project and deliver electricity to the network. One year may be too little time to develop a multi-million dollar project. Two years should be sufficient. For example, if a project was not built within two years of receiving a contract and was not withdrawn, the contract would expire. Given that permitting timelines can sometimes be unpredictable, it may be necessary to adapt this simple milestone requirement to include evidence that planning hearings or appeals are underway to prevent the contract from automatically expiring.

- The interconnection process can be and has been needlessly complex and expensive for developers in Ontario. For community-scale projects the existing process and its costs can be disproportionate to the scale of the project and this cost creates a cumbersome deterrent to participation.
- Interconnection should be made as simple as technically possible to ensure the widest participation possible in the pilot program. Currently, the time, expertise and costs associated with interconnection act as a strong barrier to community-scale projects.
- As a part of Hydro One's plan to strengthen the province's network it will undertake extensive and expensive steps to improve its system. There may be a perverse incentive to pass some of these costs to renewable generators. Network upgrades benefit all generators and all consumers. Thus it's unfair to place these burdens on renewable generators. In the first renewable RFP, costs of network upgrades were borne by Hydro One. Any unusual or extraordinary costs should be borne by the system and ultimately Ontario's ratepayers.
- OSEA recognizes that an overall review of the infrastructure requirements to support new renewable energy generation is underway, along with options for funding these costs. OSEA is prepared to work with the province on integrating solutions for community-scale projects into the broader system framework.

18. Periodic Pilot Program Review and Reporting

Since Standard Offer Contracts represent a new and innovative approach in the Ontario market there is a need to periodically evaluate the program to ensure it is meeting its objectives appropriately. Both the French and German programs have provisions for periodic review of their programs including pricing, the process and terms of interconnection. In addition, there are some potential reporting requirements for projects that would benefit the province in meeting their overall renewable energy targets.

OSEA Recommendation

OSEA recommends four areas of program review/reporting that should be considered:

- Prices and Process
- Development Rate
- Performance Monitoring
- Wind Data

Pricing and Process Review

- Every two years the OPA should report to the Minister of Energy on the status of the pilot program. This would enable OPA and the Minister to modify future contracts by increasing prices if necessary.

- However, to achieve the principal objective of the pilot program, *the five-year length of the program should not be shortened nor the initial price lowered during this period*. Prices could be raised, but not lowered.
- This assures manufacturers who locate in Ontario to serve the Ontario market that the market is stable, if not growing.
- The review can be useful for identifying obstacles to the uptake of the pilot program, for example, by correcting problems with interconnection.

Development Rate Assessment

- The periodic review of the pilot program should specifically determine if the rate of growth in renewable generation is satisfactory to meet the government's targets.
- The review should determine if development is being overly concentrated in certain areas to the exclusion of others. To gain the benefits of distributed generation, it must in fact be distributed geographically.
- The review should also identify rural areas that have benefited from the pilot program, evaluate the local and regional economic benefits and the stimulation of any new manufacturing and service jobs.

Performance Monitoring

- All participants in the program should agree to, at a minimum, an annual monitoring and performance evaluation.
- Seasonal data may be helpful as well, particularly as it relates to the correlation of generation with demand, the effect of variable renewable resources on time of day delivery, loss of load probability and their effect on spinning reserve and reserve margins.
- Data from participants should be published on the Internet in the form of downloadable spreadsheets or databases. At a minimum, tabulated data should be provided on the Internet in downloadable form.
- Wind, hydro and biomass projects should all be required to participate. For solar PV, reporting could arbitrarily be limited to any projects 10 kW or greater.

Wind Data Reporting

- Most wind projects of the proposed scale will initially collect 1-2 years of wind data before they erect turbine(s). All such wind data collected by participants in this pilot program should similarly enter the public domain.

Rationale

- For the periodic reviews to be effective, the pilot program must also provide for collecting and analyzing data on performance and other criteria.

- The proposed five-year pilot program of Standard Offer Contracts is a public program for the benefit of the communities where the renewable generation will be built, and for ratepayers. In the case of wind energy, the public's right to all wind and production data under the program requires the collaboration of participants in the pilot program.
- Quarterly performance reporting has been required from California wind projects since the mid-1980s and has not proven burdensome.
- With respect to the provision of wind data, this provides ratepayers and all Ontarians with the benefits of data that will help identify the wind resource across the province. Similar to the benefits of performance reporting, this improves the knowledge base upon which government and the private sector can act.

19. Pilot Program Administration

OSEA has provided recommendations in terms of overall responsibility for administration of the program as well as a mechanism for dispute resolution.

OSEA Recommendation

Administration Responsibility

- The pilot program can be administered initially by Ministry of Energy staff and switched to the Ontario Power Authority once it is functioning. Ministry staff have the experience necessary as result of the renewable energy RFP.

Identify Ombudsperson for Pilot Program

- Identify an Ombudsperson for the pilot program within the OPA or clearly state who is an arbiter of disputes over interconnection between the small project developer and the LDC or grid operator.
- The Ombudsperson could potentially serve as a clearinghouse within the OPA for information about the pilot program.

20. Implementation Timing

The timing for implementation of this pilot program needs to be decided within the overall timeframe of the government's renewable energy strategy.

OSEA Recommendation

- The pilot program should be implemented immediately.

Rationale

- Enough is known about the costs, about the prospects and about the need for renewable power generation to justify immediate implementation. There is no reason to delay implementation.

- An immediate start will also provide sufficient lead time for projects to begin demonstrating results in time for the first (2007) renewable energy milestone.
- Fortunately, much of the administrative work preparing contracts for winners of the renewable energy RFP can be used to prepare simplified Standard Offer Contracts for the pilot program.

21. Pilot Program Non-Price Benefits

The renewable energy RFP weighed price and price only. There are, however, other benefits that accrue from renewable energy development besides price. The decision itself by the government to close the coal plants and begin introducing renewable generation is an acknowledgement of these non-price benefits.

Economic Development

Historically, no manufacturing of renewable energy technologies has arisen in markets dominated by tendering systems. In contrast, countries that have adopted Standard Offer Contracts, such as proposed in the pilot program, dominate the manufacturing of wind turbines and biomass plants. The pattern is now repeating itself with the manufacturing of solar photovoltaics cells and panels.

The most dynamic markets for renewable technologies are found in jurisdictions with the most aggressive standard offer prices. There is a direct correlation between jurisdictions that have used or now use Standard Offer Contracts and the rate of renewable energy development and the rate of manufacturing job growth.

With the exception of distributed generation's improvement on line losses, no attempt has been made to quantify these benefits except to acknowledge that they are non-zero and should be considered.

Local & Regional Economic Benefits

David Milborrow, writing in WindStats (Vol. 17, No. 3, Summer 2004, page 1-3) on the value of wind energy in increasing employment and economic activity concludes that total non-environmental benefits of renewable energy (increased employment, improved security of supply, reduction in fuel-price volatility) are worth $0.01/kWh at a minimum and possibly double that. In particular, the benefits include:

New Jobs

- It is estimated that there are an average of 11 jobs/MW of new capacity. Contemporary wind turbines are from 1.5 to 3 MW in size.
- Each wind turbine installed therefore creates 15 to 30 new jobs when there is a stable and growing market for new renewable capacity.

Local Construction Spending

- One-quarter of wind turbine construction costs flow through the local economy. For example, of a wind turbine costing $2,000 CAD/kW, about $500 CAD/kW will be spent on local construction.
- Minnesota small wind project developers, mostly farmers, have made a point of hiring local contractors from their own communities.
- Installing a 1.5 MW wind turbine in Ontario would require about $750,000 in construction activity, much of which flows through the regional if not the local economy.

Ongoing Operations Spending

- Estimates suggest that operations and maintenance pump $5-$14 CAD/kW of installed capacity into the local economy.
- A 1.5 MW turbine would therefore create from $7,500 to $21,000 CAD sales and services that are often locally sourced.

Security of Supply

- The benefits from increasing security of supply by developing renewable energy are estimated to be worth as much as $0.01/kWh.

Local Content Requirement

Local participation and an equity interest in renewable projects are central to maximizing the economic benefits from renewable energy development for host communities and for the broader Ontario economy. To maximize these benefits for Canadians and Ontario ratepayers in particular, the government may wish to require local content as a qualification for the pilot program.

There currently is only one commercial wind turbine manufacturer in all of North America. Towers are often sourced regionally, but not always. Some towers for large North American projects have been sourced in Korea. Since there presently is a dearth of suppliers in North America for most renewable energy products it would be necessary, as in Quebec's wind RFP, to introduce local content requirements gradually to avoid strangling development in its infancy.

Education and Creation of Conservation Culture

One of the often stated goals of the Minister of Energy is creation of a "conservation culture" in Ontario. Renewable power projects, especially wind, biomass and solar plants, are highly visible and could become compelling symbols of the government's commitment to energy conservation and renewable energy. As farm writer Elbert van Donkersgoed says "to appreciate means knowing." As wind turbines, solar panels, new small hydro and biomass plants are built across the province as a result of the pilot program, consumers will begin to appreciate the importance — and the value — of electricity generated using renewable/non-polluting sources.

Distributed Generation Benefits

One of the chief benefits accruing from the modularity of renewable energy technologies is their ability to be distributed across the network. The pilot program's Standard Offer Contracts specifically enable development of distributed generation in towns, villages, cities and among farms and businesses across the province, providing the benefits that distributed generation offers: increased network stability, reduced transmission losses, longer life for transmission assets, and a diversity of sources that minimizes dependence on any one technology, owner, or fuel source.

Minimizing Line Losses

For the past decade there has been a growing acknowledgement that distributed or embedded generation reduces transmission and transformation losses. These losses average approximately 9% of total electricity consumed in Ontario. Small renewable power projects located close to load reduce the line and transformation losses on the system. The pilot program envisions participants limited to connection at 44 kV or less to assure that the generators are embedded in the system. This maximizes their contribution to reducing line losses.

While no specific payments need be made for the system benefits provided by reducing line losses, these benefits should not be ignored. They should be acknowledged in any estimate of the pilot program's costs and benefits. In the accompanying tables, the pilot program's cost to provincial ratepayers, the value of reducing line losses is set at $0.01/kWh in today's dollars.

Serving Peak Demand

There may be benefits from some technologies such as small hydro or biomass plants that can provide a portion of their generation during periods of peak demand. Storage not only enables the system to better meet peak demand but also enables it to effectively use variable resources, such as wind and solar energy, and benefit the entire electrical network.

22. Cost to the Province and to Ratepayers of the Pilot Program

There is little or no cost to the provincial treasury as a result of the proposed pilot program. Costs of fixed-price contracts are borne by all electricity consumers. There would be much less administrative cost for the pilot program than for the existing RFPs.

If the incremental cost for S.O.C is viewed in relation to overall system electricity costs, it becomes apparent that the impact is very slight. For example, if 1000MW of base wind power is installed under this program, the incremental cost/kWh over the entire rate base would be $.00050, or five one-hundredths of a cent (see Figure 13). These costs are slight because they are spread over 150TWh of electricity.

Figure 13.
OSEA Pilot Program Relative Costs.

Pilot Program Relative Costs

Cost to ratepayers per kWh

	Incremental Cost of S.O.C. $CAD/kWh	Assumed Installed Capacity MW
Base Wind SOC	0.00050	1000

23. Risk Mitigation

A number of potential risks have been identified throughout the consultation process. OSEA has responded to these items and suggested how they can be mitigated.

Risks of Delivery of Contracted Capacity

There is a concern that the province, as buyer, will have as much an administrative burden for due diligence of suppliers under the pilot program as under the RFP process.

However, this will not be the case. All financial and delivery risk remains solely with the developer under the pilot program. Standard offer contracts do not entail any significantly greater risk than contracts awarded under the RFP process. No projects under the existing RFP process have yet been built and it would be premature to believe that all will be built. Where standard offer prices are high enough to produce a reasonably profitable investment, they have resulted in more operating renewable generation than tendering systems.

Unlike the renewable RFP process, no onerous performance bonds are required in the pilot program. Onerous performance bonds are unwarranted as projects that fail to deliver energy are simply not paid. The small project developer assumes all financial risk.

Liability of the Province

Another concern is the potential exposure of the province in terms of liability. However, the province is simply the buyer of generation from the pilot program. There is no need for requiring costly liability insurance simply to protect the province from a potential liability that does not exist. The purchase of liability insurance, as are all other financial decisions, is the domain of the small project developer. Lenders will require developers to purchase insurance as necessary and prudent to protect the investment.

24. Summary and Next Steps

In summary, OSEA has developed the key framework for the implementation of a successful and industry-leading Standard Offer Contracts pilot program. The recommendations are based on sound research into the best practices around the world. The process engaged experts with these systems from the markets that have seen dramatic results in new renewable energy generation over a sustained period. These practical, proven insights have been integrated with the unique needs and structure of the Ontario market to arrive at a process that we believe will deliver rapid, cost-effective new renewable generation to the province, along with a host of economic, social and environmental benefits.

Next Steps

OSEA suggests a number of important next steps to ensure this policy framework moves from the development stage to implementation in a timely and responsible manner:

- ***Internal Review*** – clearly, the first step is review and discussion of the proposed program within the Ministry of Energy as well as other related Ministries and agencies. OSEA is prepared to be available during this period to address any questions that arise.
- ***Stakeholder Consultation*** – OSEA believes that an extensive stakeholder consultation has already been executed as part of the development of this document; however it is the prerogative of the Ministry to determine if further consultations are required. OSEA can support the Ministry in identifying key stakeholders from the community renewable energy sector, and assist in this process.
- ***Detailed Program Design*** – While OSEA has provided an extensive framework for the pilot program, additional details related to program operation and administration will need to be worked through to prepare the program to be ready for implementation. In particular, OSEA believes the interconnection aspects of the program will need to be addressed with the relevant parties as quickly as possible to ensure the details for this critical capability are completed in time for the program launch. Again, OSEA believes it can assist the Ministry in the detailed design stage.
- ***Staff Training*** – To properly administer the pilot program, staff may require specialized training, including the understanding of the pricing model. OSEA proposes that Bernard Chabot be engaged to build capacity among staff for this program.
- ***Policy Implementation*** – OSEA believes that time is of the essence if the province wants to realize the benefits of this program as well as to have sufficient time to assess its effectiveness. Accordingly, OSEA recommends that the policy for this pilot be implemented as soon as possible, within 90 days, so that participants can commence developmental activities in 2005 and the results can begin to be seen by the first renewable strategy milestone in 2007.

In closing, OSEA appreciates the opportunity to support the province in the development of this exciting pilot program. The leadership demonstrated bt the province in undertaking this initiative will result in the creation of a dynamic renewable energy market in Ontario, while helping to improve the air quality and environment for all.

Appendix A: Related Policy Mechanisms for Community Power

This document has summarized the key details of a Standard Offer Contract that is viewed as essential to facilitate the development of community-based renewable energy in Ontario. While the Standard Offer Contract program is the critical cornerstone, a number of other policy mechanisms have been identified by OSEA as having potential merit in further advancing smaller-scale renewable energy and creating a more level playing field for these projects. These are briefly outlined below; however a more detailed analysis of the options and their benefits to the Province is recommended.

1. Community Power Innovation Fund

In order to ensure the effective participation of community organizations in the delivery of Standard Offer Contracts, OSEA proposes the development of what is referred to as the Community Power Innovation Fund (CPIF).

Standard Offer Contracts (SOCs) are a market mechanism to enable small project developers to participate in meeting the province's goals for renewable energy generation. SOCs include participation by the private sector, municipalities, First Nations, community groups, co-operatives, associations of landowners, farmers, etc. However, for certain groups wanting to participate, (for example, a community organization or an association of landowners who come together for the express purpose of developing a renewable energy project), access to capital for both organization and project development is often difficult to come by. Germany's unparalleled success in the rapid deployment of renewable energy was in part due to the ready availability of low-interest loans from a revolving public fund.

Size

- $5,000,000 by end of 2005
- $10,000,000 by end of 2006

Mandate

To provide a sector specific fund to support the participation of community nonprofits and cooperative organizations in the development of green power generation in Ontario. The fund will include both a grant and loan component.

Grant Component To Cover:

- Incorporation
- Bylaw Development
- Project Planning
- Pre-feasibility study
- Communications
- Training (Project Management, Governance, Community Engagement, Technical Coordination)

Loan Component To Cover:

- Business Plan (with triple bottom line accounting)
- CED Plan and Process
- Land Option Agreement
- Land Lease Agreement
- Feasibility Study
- Interconnection Study
- Resource Assessment Study
- Environmental Assessment
- Planning Permit
- Supplier Agreement
- Power Purchase Agreement
- Offering Document and Membership Agreement

Potential Contributors

Ministry of Energy

- Tick Box on Ratepayers Bills
- Proposed Seed money ($3,000,000)

The Ontario Trillium Foundation

- ~ 2,000,000 to support community power projects from 2000-2005

Local Credit Unions

- Each would contribute a minimum of $100,000

Federal Government

- Industry Canada – Social Economy Fund
- Natural Resources Canada – Clean Fund
- Kyoto Funds

Federation of Canadian Municipalities

- Sustainable Communities
- Green Municipal Engagement Funds, Green Municipal Investment Funds

Social Capital Partners

- Up to $1,000,000

Eligibility

- Community non-profits and cooperatives;
- Joint Ventures whereby community non-profit or coop is at least an equal proponent of the project (project would be eligible for a % of funding that matches the % of ownership of the project by the community non-profit or coop;
- Project size between 3 and 10 MW;
- Incorporation of triple bottom line accounting, process for community engagement to determine social returns;
- Proof of capacity to deliver project.

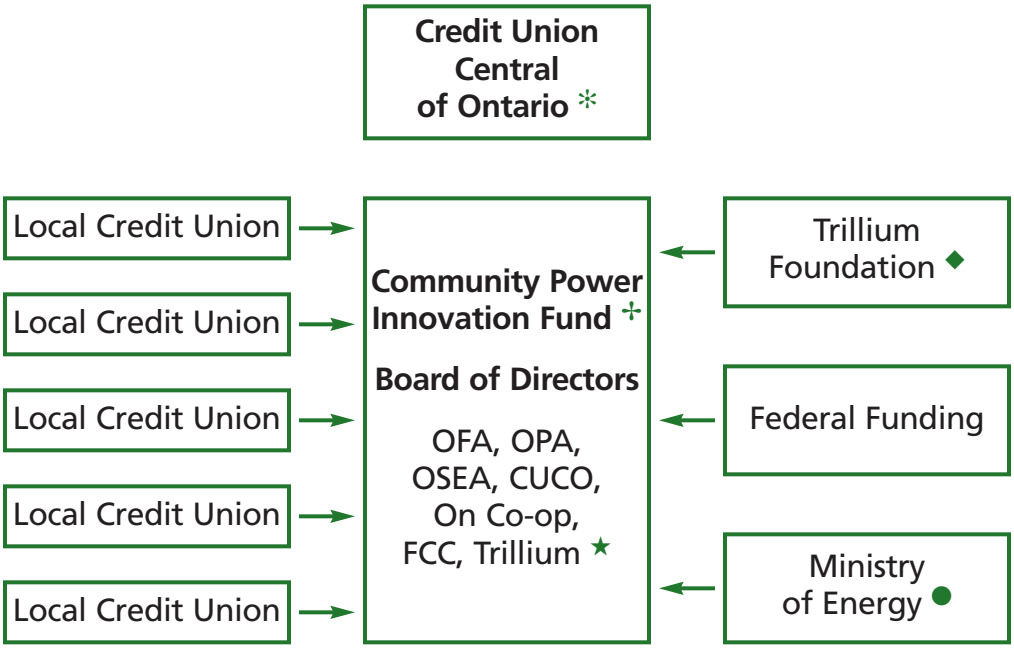
Governance

Proposed Board – Representative Organizations:

- Credit Union Central Ontario
- OSEA
- ON Coop
- Ontario Power Authority
- Farm Credit Canada
- Ontario Federation of Agriculture
- Trillium Foundation
- Industry Canada

Structure of the CPIF:

At this time OSEA is pursuing the idea of setting up the CPIF as a segregated fund of the Credit Union of Central Ontario.



NOTES:

- ✢ The Community Power Innovation Fund is intended to be a segregated fund 10-20 million in size
- ◆ The Ontario Trillium Foundation will be approached to provide $1 million/yr for a 5 year span
- ❊ Local Credit Unions in Ontario would make contributions of $100,000 to the fund
- ★ Board of Directors to be invited from the following organizations: Ontario Federation of Agriculture, Ontario Power Authority, Ontario Sustainable Energy Association, Credit Union Central of Ontario, Ontario Co-operative Association, Farm Credit Canada, Ontario Trillium Foundation
- ● The Ministry of Energy has discussed instituting an elective 'tick box' to be included on consumer electric bills that would donate a percentage of funds to the development of community power through the Community Power Innovation Fund

2. Community Small Business Investment Funds

Another opportunity to level the playing field and provide access to capital for small community-oriented developments is through a tax-advantaged mechanism such as the provincial Community Small Business Investment Funds (this program was closed last year). In doing so, the province can tap an entirely new segment of investors to help finance new renewable projects resulting in an increased pool of capital available for developments.

In the case of community-based initiatives it is essential to create a level playing field for attracting investors. Renewable energy projects are normally capital-intensive. Consequently, access to capital is critical to the success of these projects. However, the current conditions disadvantage these projects as well as individuals who wish to invest in them. The project is disadvantaged since other private developers can more readily access capital from labour-sponsored, or other funds while the community project cannot. Individuals in communities may wish to invest in a project that directly benefits their community but they are denied the tax benefits that are available to other investors through labour-sponsored funds. The creation of community-sponsored venture capital pools can facilitate the access to capital required to encourage renewable project development.

Currently, a significant source of venture capital for small and medium-sized businesses is through the Labour Sponsored Investment Funds (LSIF) and, until recently, Community Small Business Investment Funds (CSBIF) programs. These Funds are highly attractive to investors given their combination of tax credits, incentives and RRSP eligibility. For LSIFs, a $5,000 investment would result in $1,500 in provincial and federal tax credits along with a full income tax deduction of $1,603 (if held in an RRSP; *assumes taxable income between $39,001-69,509*), for a total tax savings of $3,103. Similarly, the CSBIFs provided a cash incentive of 15%, and was to increase to 30%. Community-based green energy projects are perfectly aligned with these Fund objectives, since the financial benefits and jobs stay in the community.

The previous guidelines for these funds do not accommodate the unique needs of community-based green energy projects. There are four primary changes that would make the CSBIFs more suitable:

Minimum Investment Level – Currently, CSBIFs require a minimum individual investment of $25,000. The concept of a community-based project is based on a larger pool of smaller everyday investors who typically invest between $500-5,000. Reducing the minimum to $500 would enable greater participation by communities and therefore provide more capital to the projects.

RRSP Eligibility – LSIFs are RRSP-eligible. However, the CSBIF itself is not directly RRSP-eligible. We recommend that CSBIFs become automatically RRSP eligible.

Maximum Size of Fund – Currently, CSBIFs are capped at $10 million. However, even small renewable energy projects, such as a wind farm, require greater capital, normally between $15-25 million. It is recommended that the maximum fund size be increased to $25 million.

Maximum Investment In Any One Project – CSBIFs are restricted to a maximum investment in any one business of 20%. Coupled with the cap on the size of the fund this restricts the ability of these funds to support the level of capital required for a single project. It is recommended that a CSBIF be permitted to invest 100% of the funds raised in a single, specific community-based project. Experience has shown that communities can be galvanized around the idea of a project such as a wind farm and individuals are looking to invest via a single entity focused on the specific project.

While these recommendations have focused specifically on changes to the previous CSBIF Program, the thrust of the recommendations is not intended to be restricted to this program. Alternative policy incentives could be developed to deliver the same benefits.

Appendix B: Stakeholders Consulted in Policy Development

The Ontario Sustainable Energy Association undertook an extensive stakeholder consultation process in the development of the proposed pilot program for Standard Offer Contracts. The following list summarizes the various participants who were consulted and provided input or comments related to this document.

Byron Leclair
Elyot Waller
Peter Ormond
ADEME (Agence de l'Environnement et de la Maîtrise de l'Energie) — Bernard Chabot
American Council On Renewable Energy (ACORE) — Michael Eckhart
American Wind Energy Association MidWest — John Dunlop
ANF Energy Solutions Inc — Aidan Foss
Arigna Fuels Ltd. — Michael Layden
ARISE Technologies Corporation — David Elzinga
Association of Power Producers of Ontario — Jake Brooks
Bodycote Materials Testing Canada Inc. — Tonya Dhir
Canadian Renewable Energy Association — Bill Eggerstson
Canadian Solar Industries Association — Rob McMonagle
Canadian Wind Energy Association — Robert Hornung
Center for Environmental Economic Development (CEED) — Daniel Ihara
Christian Farmers Federation of Ontario — Elbert van Donkersgoed
Community Office for Resource Efficiency — Randy Udall
David Suzuki Foundation — Jose Etcheverry
Eco Perth — David Poch
Eole — Jean-Louis Chaumel
First Solar — Glenn Hamer
Gartner Lee Limited — Ramani Hariharan M.S., P.Eng.
GE Energy Power Generation — Derek Lim Soo
Generation Solar Renewable Energy Systems — Simon Boone
Greenpeace Canada Climate Change Campaign — Dave Martin
Hearthmakers Co-operative — Steve Sottile
Helimax — Marion Hill
Helix Synergy Inc. — Winton Dahlstrom
Hydro Quebec — Bernard Saulnier
Invenergy Wind Canada — Gary Pundsack
Lawrence Berkeley Laboratory — Mark Bolinger
Leader Wind Corp. — Jennifer Lugtigheid
Manitoba Energy Science and Technology — Shaun Loney
Minnesota Environmental Quality Board — Larry Hartman
National Farmers Union in Ontario — David Hahn
National Farmers Union in Ontario — Don Mills
Ontario Clean Air Alliance — Jack Gibbons
Ontario Federation of Agriculture — Ted Cowan
Ontario Ministry of Agriculture — Julian Reed
Ontario Ministry of Agriculture — Jake DeBruyn
Ontario Ministry of Energy — Perry Cecchini
Ontario Ministry of Energy — Ken Nakahara
Ontario Ministry of Energy — Bryan Young
Ontario Sustainable Energy Association — James Murphy
Ontario Sustainable Energy Association — Deborah Doncaster
Ontario Sustainable Energy Association — Paul Gipe
Ontario Sustainable Energy Association — Melinda Zytaruk
Ontario WaterPower Association — Paul Norris
Oregon Office of Energy — Carel DeWinkel
Phantom Electron — Leonard Allen
Phantom Electron — Joel Phair
Pollution Probe — Mary Pattenden
Pollution Probe — Martin Tampier
Port Albert Wind Farms, Ltd. — Philipp Andres
Positive Power — Jen Heneberry
Positive Power — John Norman
Renewable Energy Research Laboratory — Jim Manwell
RePower Systems — Theodor Peters
Schneider Power — Thomas Schneider
Sierra Club of Canada — John Bennett
Sierra Club of Canada Legal Defence Fund — Albert Koehl
Sierra Club du Canada National Office — Shawn-Patrick Stensil
Sky Generation Inc. — Glen Estill
Solar Energy Society of Canada
Superior Renewable Energy Co-operative — Charles Campbell
Superior Wind Energy — Claude Mindorff
Sustainable Energy Ireland — Paul Kellet
The Renewable Energy Co-operative North — Robin Hughes
The Renewable Energy Co-operative North (TREC North) — Anna Gibson
Toronto Environmental Alliance — Keith Stewart
Toronto Hydro Energy Services — Joyce McLean
Toronto Renewable Energy Co-operative — Ed Hale
Toronto Renewable Energy Co-operative — David MacLeod
Toronto Renewable Energy Co-operative — David Timm
University of Birmingham — Dave Toke
University of Salzburg — Volkmar Lauber
University of Waterloo — Ian Rowlands
West Wind Development — Mark Bell
Windfall Ecology Centre — Brent Kopperson
Windfield Energy Inc. — Benjamin Strehler
Windustry Project — Lisa Daniels
Wisconsin Energy Bureau — Alex De Pillis
Worldwatch Institute — Janet Sawin
York University — Robert MacDonald
York University Schulich School of Business — Karen Chiykowski

401 Richmond Street West, Suite 401
Toronto, Ontario M5V 3A8
Ph: 416-977-4441
Fax: 416-977-2157

www.ontario-sea.org

August 26, 2005

Memorandum to:

Ontario Power Authority
Supply Mix Submissions
175 Bloor St. E., North Tower, Suite 606
Toronto, ON
M4W 3R8

SUBJECT: Ontario's Waterpower Resources and Potential

I am writing on behalf of the province's primary renewable energy industry to provide the Ontario Power Authority with input and advice with respect to the question of the province's "supply mix" over a time horizon of the next ten to twenty years. Given the pending initiative to develop an Integrated Power System Plan, it is imperative that the OPA and the government appreciate the existing contribution waterpower makes to the integrity of the system, and the significant potential remaining in the province.

In addressing the challenges facing the province's energy future, it is important to value the relative role of various generation sources to the overall system. With respect to waterpower, this value was most accurately described in the recent Independent System Operator's 10-Year Outlook, an excerpt of which follows:

"The flexibility of hydroelectric generation has always been of value but its importance will increase even more in the future. Coal-fired generation, while not as flexible, currently provides an important capability to meet load pick up and drop out requirements. That capability may be reduced when the coal plants shut down. Conservation, while reducing overall requirements, will not likely change the load pick-up requirement. Demand management is likely to help reduce peak demands but is not likely to affect ramping requirements. Gas-fired generation will have the required flexibility but even it can be limited if the plant is an efficient cogeneration facility. Given the expected future mix of resources in Ontario, the value of hydroelectric flexibility will increase." I have attached for your reference a Fact Sheet documenting waterpower's flexibility in the Ontario system and emphasizing the value of storage.

As suggested in the Call for Written Submissions, evaluation of energy options should be based on a framework that ensures equitable comparison, such as life-cycle analysis. By any such measure, new waterpower is advantageous. Consider, for example, that the vast majority of the close to two hundred operating facilities in Ontario are more than fifty years old, and many are approaching 100 years of efficient, reliable operation. Comparative analyses, whether on the basis of environmental targets (e.g. green house gas emissions, energy pay-back ratios), or economic objectives (e.g. long-term production costs, stability of fuel prices) consistently demonstrate that waterpower outperforms alternatives. I have enclosed some examples of life-cycle analyses of energy options for your consideration.

It is also apparent that there is a "provincial interest" in optimizing waterpower production, both in terms of contributing to energy security and in supporting local and regional economies. As articulated by Energy Minister Dwight Duncan earlier this year:

"Our government is interested in maximizing every source of renewable energy that is available to us. We are particularly interested in expanding our supply of hydroelectric power. Through our request for proposals for renewable power and through the efforts of my colleague, the Minister of Natural Resources, we are removing barriers to achieving Ontario's potential for additional waterpower in our province. Why? Because it's clean, affordable, sustainable and reliable".

It is clear that increasing waterpower production should be a preferred option and an integral component of Ontario's "system mix" over the next 5-20 years and beyond. It is of concern, therefore, to note that recent public policy appears to have been premised on the assumption that there are few waterpower opportunities left in the province. In many regards, this misconception has become a self-fulfilling prophecy that must be rectified through this and subsequent initiatives. By way of example consider that:

- As recently as 2001, regional land use planning placed new waterway parks on existing waterpower-producing systems and sites with considerable potential. While these decisions can be reversed, they were made in the absence of the consideration of energy values.

- The considerable waterpower potential existing in northeast and northwest Ontario is significantly transmission-constrained, (Renewables RFP II has a limit of 50MW in the northeast). This potential could be liberated through proactive transmission policy, including optimization of the proposed line to Conawapa.

- Crown land policy (2004) does not yet realistically address the potential of the Albany, Winisk, Severn, Attiwapiskat and Moose River Basins, yet thousands of megawatts have long been identified as practical to develop.

In order to address the apparent misconception regarding the possibility for waterpower to play an expanded role in Ontario's system mix, and in response to the OPA "Call for Written Submissions", the Ontario Waterpower Association, in partnership with the Ontario Ministry of Natural Resources, issued a request for proposals for the Evaluation and Assessment of Ontario's Waterpower Potential. I have appended for your reference a copy of the RFP. The contract was awarded to Hatch-Acres, a leading environmental and engineering firm with considerable direct experience in waterpower assessment and development in Ontario. This submission summarizes the detailed review and evaluation undertaken by Hatch-Acres. I would be pleased to share complete site-specific and drainage basin information with the appropriate OPA staff.

The results of this review have clearly demonstrated that Ontario's waterpower production could conservatively grow by at least 50% within the next 5-15 years. Based on current projections, it would not be unreasonable to expect that waterpower could expand to meet one-third of the province's energy requirements within the timeframe being considered.

The detailed analysis undertaken indicates that in the short term over 1,100 MW of new development and redevelopments is either already committed or projected to be completed within the next 5 years.

In the medium to longer term, and with the appropriate political will, the following is available and practical to pursue:

- 150 to 250 MW of potential at greenfield sites of less than 10MW
- 400 – 500 MW of potential exists at greenfield sites between 10MW and 100MW
- 3,000 – 4,000 MW at known larger sites
- redevelopments and new powerhouses at existing dams could add almost 200MW
- pumped storage projects can be relied upon to contribute up to 1000MW

In total, a realistically conservative estimate of the additional practical new waterpower potential ranges from 4,500 to 5,500 MW. As you will appreciate "practicality" is a function of the time at which an assessment is undertaken and the public policy framework (economic, environmental, social) that is in place. Much more raw "hydraulic potential" has been documented in the province and not included in the figures above.

As suggested at the outset, the waterpower industry considers the question of the proposed "system mix" as key to the integrated system planning initiative scheduled to commence in early 2006. The process will be, by definition, iterative with new information, policies and economic realities influencing the ultimate "balance of power". I am confident that the estimates provided herein are accurate for the present conditions and can serve as the basis for the first iteration of planning.

I would be pleased to meet with OPA representatives to discuss our submission in greater detail.

Sincerely;

Paul Norris,
President,
Ontario Waterpower Association

c.c. Ministry of Energy
Ministry of Natural Resources

Request for Proposals:

Evaluation and Assessment of Ontario's Waterpower Potential

Background:

On July 4, 2005, the Ontario Power Authority (OPA) initiated a consultation process in response to a written request from the Minister of Energy regarding recommendations on the long-term electricity "supply mix" for the province. Specifically, the Minister has requested a report to government by December 1, 2005 that provides:

- recommendations with respect to conservation targets for Ontario for 2015, 2020 and 2025, taking into account the targets already for 2007
- recommendations with respect to additions of new renewable energy by 2015, 2020 and 2025, taking into account the targets already set for 2007 and 2010
- recommendations with respect to the appropriate mix of electricity supply sources to satisfy the remaining expected demand in Ontario, after conservation and renewable sources have been taken into account, and with particular attention to base-load, intermediate and peak availability of energy.

In response to the Minister's request, the OPA has launched a two-stage consultation process. Initially, written submission will be accepted by the OPA until August 26, 2005. In addition, the OPA has issued a Request for Proposals for consultant services to provide additional consultation and evaluation.

The OPA requests have identified specific "issue areas" within which advice is being sought. Of particular relevance to the waterpower sector are the following:

- analytical planning approaches that focus on assessment of risks, environmental attributes and cost characteristics of various portfolios;
- assessments of different supply technologies and resources in the Ontario setting utilizing recent source information or current data on capital and operating costs, performance characteristics, technology life-cycle, environmental impacts and any other relevant characteristics; and
- methods to asses the impact on the natural environment of supply options.

A copy of the OPA consultation framework is attached.

The OPA initiative on supply mix will feed directly into the development of the Integrated Power System Plan, consultation on which is scheduled to begin in early 2006. It is imperative, therefore, that the best available information is provided to this initiative. Given that there has not been any significant waterpower development in Ontario for more than a decade there has been a presumption that "there are no opportunities" remaining. The "system mix" question offers a unique opportunity to correct this assumption.

While there are numerous previous studies and assessments of waterpower potential in Ontario most of those are dated, as are the assumptions underlying them. The OWA, on behalf of the waterpower industry, seeks independent expertise to review and re-evaluate Ontario's remaining waterpower potential.

Scope of Work:

The scope of this initiative is focused on the analysis and assessment of waterpower potential in Ontario and the identification of practical limitations to realizing that potential. As such, the consultant will be required to:

- undertake required background research
- review and evaluate source information
- assess and quantify green-field and redevelopment waterpower potential on a tertiary watershed basis
- identify seasonal and annual storage and peak generation opportunities
- identify river systems within a tertiary watershed that could be optimized for waterpower production
- re-evaluate previously identified "significant" opportunities
- identify and rank opportunities that warrant further investigation
- identify practical (e.g. riparian interests) and policy (e.g. parks) limitations to realizing identified potential
- provide documentation of the methodology used as the basis for assessment and ranking
- provide "confidence limits" for the assessments and evaluations undertaken

A draft report is to be submitted August 15, 2005

Final report is due August 22, 2005

The final report will be the property of the Ontario Waterpower Association. The proponent will be required to execute a data security and confidentiality agreement.

Access to information:

The proponent will be provided access to:

- all relevant data and reports presently held by the Ontario Waterpower Association
- all relevant data and reports presently held by the Ontario Ministry of Natural Resources
- selected data and reports presently held by members of the Ontario Waterpower Association

Qualifications:

The proponent must be or intend to become a member of the Ontario Waterpower Association or submit a proposal in partnership with a member.

The proponent must have demonstrated experience in regional and site-specific hydrologic and hydraulic evaluation and assessment.

The proponent must have demonstrated knowledge of Ontario's waterpower industry.

The proponent must be familiar with the policy framework for waterpower development in Ontario.

The proponent must possess the required analytical tools and/or software to undertake the evaluation – experience GIS applications, digital elevation models and flow assessment tools is particularly applicable

Submission of Proposals:

Written proposals must be submitted by 4:00 p.m. on Friday, July 22, 2005 to the address, fax or e-mail below.

Proposals must include:

- description of qualifications as outlined above
- description of project plan
- proposal bid price

The OWA reserves the right not to select any proposal.

All inquires and proposals to be directed to:

Paul Norris
President
Ontario Waterpower Association
Suite 110, 380 Armour Road
Peterborough, Ontario
K9H 7L7
Phone: 705-743-1500
Fax: 705-743-1570
e-mail: pnorris@owa.ca

COMPARING

Power Generation Options

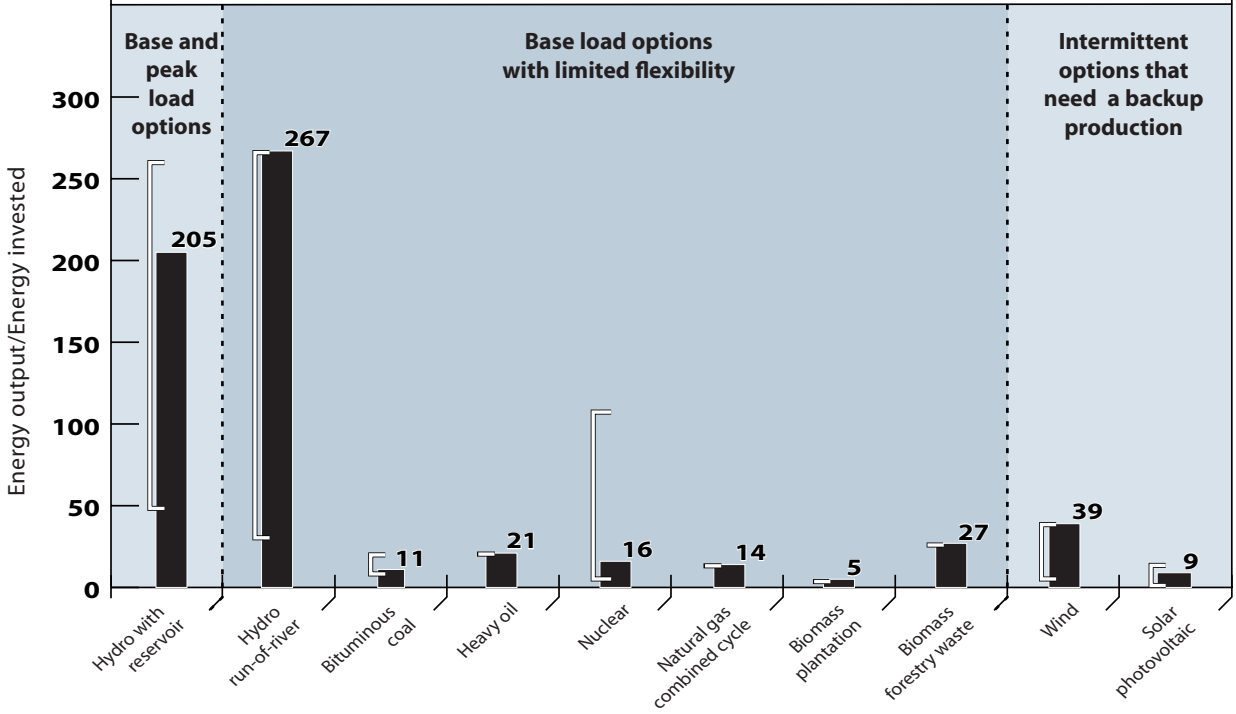
Energy Payback

Environmental Issues

For each power generation system, the "energy payback" is the ratio of energy produced during its normal life span, divided by the energy required to build, maintain and fuel the generation equipment.

If a system has a low payback ratio, it means that much energy is required to maintain it and this energy is likely to produce many environmental impacts. For fossil fuels, it means environmental impacts at extraction, transportation and processing of fuels. For renewable sources, it means environmental impacts at building the facility. If an option has a ratio of close to one, it means it consumes almost as much energy as it produces, so it should never be developed.

Figure 1 - ***Energy Payback Ratio of Energy Options***



Bars indicate values that should be representative of the northeastern region of North America, for existing technologies.

The range of values, showed by white lines, indicates the spread of all values found in the literature. These values are representative of different energy systems everywhere in the world.

Understanding the Results of Studies

In the recent context of climate change commitments, life-cycle assessments have focused mainly on greenhouse gas emissions of energy systems. These assessments are essential. However, the emissions can vary dramatically according to their context. For example, if a system utilizes aluminum as a building material, the assessment will vary greatly whether the aluminum smelters use hydropower or electricity from coal.

Because the "energy payback ratio" is less affected by upstream choices of energy supply, it has the advantage of minimizing the fluctuation when evaluating greenhouse gas emissions. It should therefore be considered as one of the most reliable indicator of environmental performance.

If this indicator minimizes some fluctuations in results of studies, it does not eliminate them. The data in figure 1 shows that payback ratios do not vary much for fossil fuels but vary significantly for renewable energies. This is due to variable site conditions (topography for hydro, quality of the wind, intensity of solar radiation for solar energy).

METHOD

Life-cycle analysis
Some studies on energy options consider emissions at power plant only, while values cited in this fact sheet are based on a life-cycle assessment (LCA). For each energy options, the whole energy system is studied.

***Fossil fuel or nuclear systems**: exploration and resource extraction, preparation, transportation, storage of fuel, construction of plant, combustion, maintenance, dismantling.*

***Renewable systems**: construction of plant, maintenance, dismantling.*

Level of service
To point out the fact that life-cycle analysis does not consider the level of service, figure 1 has been divided into three categories: base and peak laod options / base load options with limited flexibility / intermittent options that need a backup.

Main Findings concerning "Energy payback ratios"

Hydropower clearly has the highest performance, with energy payback ratios of 205 and 267 compared to fossil fuel systems which have a range of 11 to 21. The chosen typical figures, 205 for hydro with reservoir and 267 for run-of-river, are for projects in Québec, assessed over a period of 100 years.

In figure 1, wind power, for the best wind sites, also has a good performance (ratio of 39). However, this ratio is overestimated because the calculations did not consider the need for backup capacity to compensate wind fluctuations. The level of service of wind power is very low, even when many wind sites are spread out over a large territory.

Biomass also has a good performance (ratio of 27) when electricity is produced from forestry wastes. But when trees are planted for the purpose of producing electricity, the ratio is much lower (about 5), because the exploitation of these biomass plantations require many energy input. For these two biomass options, distance between the source of biomass and the power plant must be short, otherwise the energy payback ratio drops to very low values.

Future performance of energy systems

Fossil fuels already have low energy payback ratios and these will be declining over the next decades. This is due to multiple factors:

- **As the best fossil reserves are depleted,** they tend to be replaced by wells that require a higher energy investment (located in far away regions or under the sea).
- **Other considerations** may involve selecting resources that are located at greater distances. For example, transportation of coal by train in the US has increased in the last decade because users tend to select Western low sulfur coal.
- **In the future,** there will be more energy wasted in fossil fueled power plants to reduce emissions. Scrubbing of sulfur reduces the efficiency of a plant. If capture and sequestration of CO_2 becomes commercially available, this will involve spending huge amounts of energy in the operation of scrubbing and disposal equipment.
- **The only fossil fuel that should maintain its performance is natural gas,** because the previous negative factors can be offset by more efficient combustion turbines.

Study results produced for the International Energy Agency

Authors: Luc Gagnon, gagnon.luc@hydro.qc.ca
In collaboration with Camille Bélanger, Enviro-science

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Hydro Québec

Greenhouse Gas Emissions

Why is **climate change** an important environmental issue?

In 2001, the Intergovernmental Panel on Climate Change (IPCC) produced a report on the impacts of climate change. In the *Summary for Policymakers* (pp. 7 and 14), the panel assesses the following impacts as "likely" or "very likely":

- ***"More intense precipitation events: increased floods, landslide, avalanche, and mudslide damage."***
- ***"Increased summer drying over most mid-latitude continental interiors and associated risk of drought."***
- ***"Increase in tropical cyclone peak wind intensities, mean and peak precipitation intensities."***
- ***"Intensified droughts and floods associated with El Niño events in many different regions."***
- ***"Sea-level rise and an increase in the intensity of tropical cyclones would displace tens of millions of people in low-lying coastal areas of temperate and tropical Asia."***

In Canada, as in all northern countries, climate change is expected to be extremely rapid under the business-as-usual scenario. This means that ecosystems would have to "migrate" about 1,000 km northward in just 50 years. But forests cannot "move" at this speed. Forest fires and major dieback will result, affecting the overall productivity of forests.

Many northern species will also be endangered by climate change, e.g, polar bear, beluga, caribou. In a recent publication entitled *Sensitivities to Climate Change in Canada*, Natural Resources Canada concludes that: "The climate change associated with a doubled atmospheric concentration of CO_2 may virtually eliminate salmon habitat from the Pacific Ocean."

What **pollutants** cause **climate change?**

The main greenhouse gases (GHG) are carbon dioxide (CO_2) and methane (CH_4). Both are directly related to energy systems. Any combustion will produce CO_2. CH_4 is emitted during the extraction of coal and natural gas. Any leakage in the distribution of natural gas will also result in CH_4 emissions, because commercial natural gas is composed of about 95% CH_4. Other greenhouse gases (N_2O, CFC, HFC, PFC) are rarely included in the assessment of energy options, because of the low volumes emitted.

The various GHGs do not have the same effect on the climate. To take their differences into account, the IPCC has produced indicators of ***global warming potential***, relative to CO_2. In most studies, each GHG is converted to an equivalent of CO_2 and added to the inventory. For example, a gram of CH_4 has a ***global warming potential*** of 23, relative to a gram of CO_2 (over a 100-year period). The data in Figure 1 is expressed in CO_2 "equivalent," meaning that CH_4 emissions are included with CO_2 emissions.

Which **energy option** is responsible for **climate change?**

Rigorous comparisons must be based on life-cycle assessment
(see Figure 1 and Table 1)

To compare energy options fairly, all emissions from an energy system should be included. Recent studies, called life-cycle assessments, include emissions from fuel extraction, processing and transportation, as well as from power plant construction and electricity generation. Figure 1 and Table 1 present the results of life-cycle assessments (LCAs), with typical data for eastern North America.

For each fossil fuel, Figure 1 includes two results: one for the technology typically in operation, and another for a high-performance modern technology (commercially available). For renewable sources, such as hydro or wind power, it is impossible to select one "modern technology," as performance depends mainly on site-specific conditions. For these options, Figure 1 includes two results: one for a typical existing project, and one for a very good site that will be available in the near future.

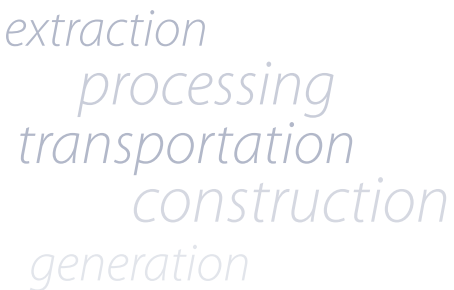

Figure 1 – Life-cycle assessment of greenhouse gas emissions (kt eq. CO_2/TWh)

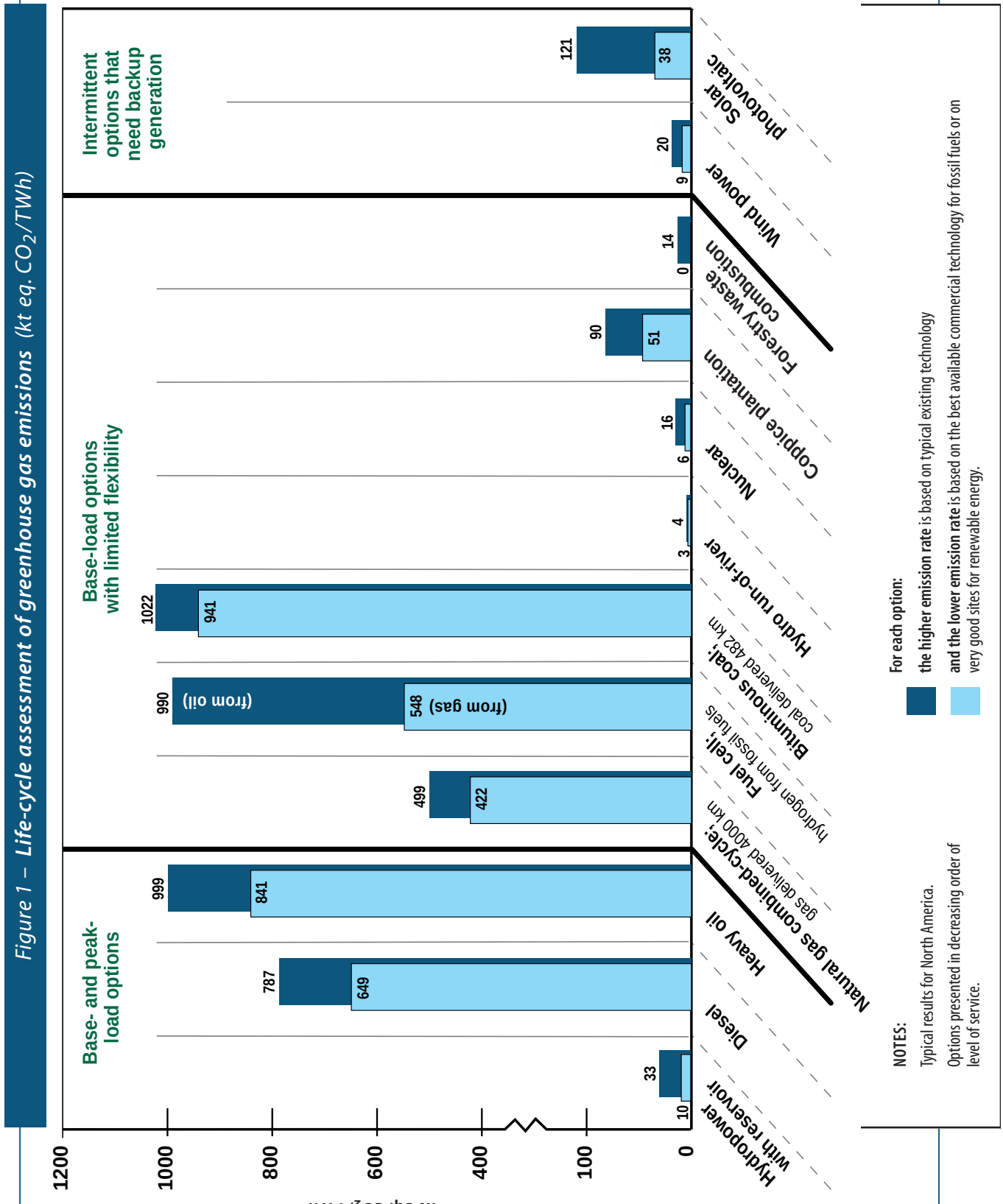

*Table 1 – **Life-cycle assessment of greenhouse gas emissions** (kt eq. CO_2/TWh)*

Generation options (classified by level of service)	Typical results for North America: Best commercial technology (very good sites for renewables)	Typical results for North America: Typical existing technology	Typical results for North America: Source of data	Technical comments: Notes on thermal generation • Assessment without cogeneration • Scrubbing of SO_2 would increase GHG emissions from coal and oil.
Hydropower with reservoir	**10** reservoir = 40 km² /TWh	**33** reservoir = 160 km² /TWh	HQ	Estimates include gross emissions from boreal reservoirs, which overestimates their real net emissions.
Diesel	**649** Plant eff. 43%	**787** Plant eff. 35%	NRCAN industry data	
Heavy oil	**841** Plant eff. 38%	**999** Plant eff. 32%	NRCAN industry data	
Heavy oil from oil sands	**1019** Plant eff. 38%	**1177** Plant eff. 32%	Cdn Climate Change Secretariat	Extraction/processing: Oil sands 203 kt CO_2 /TWh Conventional oil - 25 kt CO_2 /TWh Added emissions = 178 kt CO_2 /TWh
Natural gas combined-cycle turbines; gas delivery 4000 km	**422** Plant eff. 58%	**499** Plant eff. 49%	US NREL + efficiency change	Extraction/processing about 50 kt /TWh Transportation 4000 km = about 65 kt /TWh
Fuel cell; hydrogen from fossil fuel	**548** H from gas; Cell eff. 55%	**990** H from oil; Cell eff. 55%	US NREL reforming + efficiency	Gas delivered over 4000 km
Bituminous coal; coal delivered 482 km	**941** Plant eff. 35%	**1022** Plant eff. 32%	US NREL	• Surface mining; average user by river • For farthest user: emissions + 6%
Lignite		**1340**	Dones	
Peat		**1300**	Kivisto	
Hydro run-of-river	**3**	**4**	HQ, Vattenfall, Dones	
Nuclear	**6**	**16**	Vattenfall, Dones	
Short rotation coppice plantation	**51** Plant eff. 30%	**90** Plant eff. 30%	Matthews, UK + distance changes	Coppice transportation distances = 20 km (for 51) and 100 km (for 90)
Forestry waste combustion	**0**	**14**	Vattenfall + correction for CH_4 from wastes	Zero rate assumes that, if not used, some waste would decay and create CH_4 emissions.
Wind power	**9**	**20**	White	2 sites in Wisconsin, average use factor of 24%
Solar photovoltaic	**38**	**121**	Vattenfall, Dones	Emissions from fabrication process

Rigorous comparisons must consider:

• the level of reliability and flexibility

In Table 1, options are presented in decreasing order of level of service. This issue is important, because storing electricity in large quantities is very expensive and a reliable electricity supply must be achieved by generating electricity at the same time as it is consumed. If the balance between production and consumption is not maintained, frequency fluctuations will result, with major impacts on electrical equipment such as computers or appliances. Many ancillary services are required to provide reliable electricity:

- Presence during the maximum peak load
- Capacity to meet hourly and daily variations in load
- Frequency and voltage control, to keep transmission voltages within the required ranges
- Regulation, to maintain minute-to-minute generation/load balance

Generation options are not all equally capable of providing such services. Reliable electricity networks cannot depend only on "must-run" generation such as nuclear energy or on intermittent energy such as wind power, which requires a backup option to compensate for fluctuations. In comparison, hydropower with reservoir or diesel plants can provide all the services required for reliable electricity.

• the many purposes of hydro projects

The assessment of hydropower is exceptional, because a reservoir can have many purposes, such as modulating power generation, irrigation, flood control and water supply. If irrigation uses a lot of water, this may reduce the overall electricity generation, thereby affecting the performance of a project (per kWh). To make a fair comparison among power generation systems, the assessment of hydropower should include only projects designed strictly to generate electricity, or else the parameters should be corrected to attribute impacts to other purposes.

generation
modulation
irrigation

Main findings concerning GHG emissions

- The options with the **lowest emissions are run-of-river hydropower, wind power and nuclear**. We should remember, however, that their production cannot be modulated to meet peak demand; often, fossil fuels will be needed to support these options.
- **Hydropower with reservoir** has a slightly higher emission rate. Overall, it should be considered as the option with **the best performance**, because of its reliability and other potential services such as flood control, irrigation, and water supply. (There is still uncertainty, however, concerning GHG emissions from tropical reservoirs, an issue discussed in detail in another fact sheet.)
- **Coal** (modern or old plant) clearly **has the highest emission factor**, with twice the emissions of natural gas combined-cycle turbines.
- **Heavy oil also has a very high emission rate**. If the oil is extracted from oil sands, the emission factor is as high as for coal.
- **Among fossil fuels, natural gas combined-cycle turbines have the best performance**. The reported emission rates include emissions associated with delivering the gas over 4,000 km (typical for northeastern consumption). Emissions could be about 12% less for plants located close to gas wells. The emission rate could be further reduced with cogeneration. This is discussed in the next pages.
- **Biomass can have an excellent performance**, notably the use of forestry wastes within industries. The performance of biomass plantations is dependent on the energy expended in exploitation activities. The reported emission rates for short-rotation coppices depend on the average distance between the power plant and the source of biomass (20 and 100 km).

Expectations created by "new" technologies

- **Fuel cells and hydrogen production**

  Fuel cells consume hydrogen and emit no direct GHG emissions. They have raised high expectations concerning GHG reductions, but life-cycle assessments show that these expectations are unfounded. Currently, the only low-cost option to produce hydrogen is natural gas reforming, with a life-cycle emission rate higher than burning gas in a combined-cycle turbine. If fuel cells are used in regions without gas distribution, the reforming of oil leads to emissions similar to those of coal-fired generation.

  Some have proposed a truly clean and reliable system, with the following steps:

  1. Wind power providing electricity to a water electrolysis plant, producing hydrogen.
  2. Compression and storage of hydrogen.
  3. Fuel cells would consume the hydrogen when electricity is needed.

  In theory, this system is interesting because it offsets the intermittent character of wind power. In reality, it is very inefficient: electrolysis has an efficiency of 70%, hydrogen storage needs energy for compression, and fuel cells are 50% efficient. This means that, starting with wind power at 6¢/kWh, the final cost of electricity ends up as more than 20¢/kWh. This system will not be competitive for many decades.

CO_2 scrubbing and sequestration

Another technology that has raised expectations is CO_2 scrubbing and sequestration. The CO_2 must first be "captured" from flue gas and then pumped to an empty oil or gas well, which must be "air-tight." This will be a huge task, as demonstrated by a comparison with SO_2 scrubbing. Even if the sulphur content in coal is only 1% or 2%, SO_2 scrubbing generates huge amounts of waste. Very few plants are equipped with scrubbers, because of the high cost and waste management problems. In the case of CO_2, the carbon responsible for such emissions makes up more than 50% of the coal. CO_2 scrubbing and sequestration is technically possible, but will require huge amounts of energy, creating more pollution. The efficiency of a thermal power plant with a CO_2 removal system can be reduced by 30%. If the storage well is located far away, the energy required for pumping could equal half the energy generated by the plant. Overall, the economic viability and environmental benefits of CO_2 scrubbing are still doubtful.

Cogeneration and the performance of thermal plants

Cogeneration, or Combined Heat and Power (CHP), plants have the potential to improve energy efficiency and reduce GHG emissions. But the word "cogeneration" can be misleading, because some low-efficiency cogeneration units can emit more GHGs than efficient separate equipment (one for industrial heat and another for electricity generation). In many cases, plants have been considered cogeneration plants, even though only a very small fraction of the waste heat is actually used. In many cases, these plants have a worse environmental performance than efficient plants that produce only electricity. Because of this situation, the European Commission is planning a directive on "Quality-CHP."

In theory, a cogeneration plant with full heat utilization can achieve an overall efficiency of 90%. What is the meaning of this maximum efficiency in terms of reducing GHG emissions? In a scenario involving only natural gas (no fuel substitution), if the cogeneration plant replaces a combined-cycle gas turbine with 54% electrical efficiency and a heat boiler at 90% efficiency, the GHG reduction will be about 25% (Eurelectric, p. 53).

In North America, cogeneration plants are rarely very efficient, because the emphasis is more on producing electricity than enhancing the use of waste heat. In order to achieve very high efficiency, the size of the gas turbine must be adapted to the local use of heat, and plants would have to be much smaller than they generally are.

Conclusion: Effective technologies to reduce emissions

Based on LCA, we can conclude that, in the electricity sector, fuel cells and CO_2 scrubbing are unlikely to seriously reduce GHG emissions over the next 20 years. Moreover, the widespread implementation of these technologies is unnecessary when we consider the numerous well-tested technologies that can actually reduce emissions:

- Hydropower, wind power and nuclear energy
- Natural gas combined-cycle turbines, replacing coal
- "Quality" cogeneration in thermal plants
- Energy efficiency measures

Therefore, short-term emission reductions do not require new generation technologies, only measures to favor the proper options.

Note concerning **GHG emissions from reservoirs**

Recent research on aquatic ecosystems supports the following statements:

- Many research programs have confirmed significant GHG emissions at the surface of all types of water bodies (reservoirs, natural lakes and rivers).
- Most of the flooded biomass at the bottom of reservoirs has not decomposed after decades under water.
- After the initial first few years (after impoundment), GHG emissions from reservoirs are similar to those of nearby natural lakes. These emissions, either natural or from old reservoirs, are mainly due to organic carbon that is flushed into reservoirs from surrounding ecosystems.

Thus, emissions measured at the surface of reservoirs must be considered "gross" emissions, that systematically overestimate the level of GHG emissions for which reservoirs are responsible. "Net" emissions must be defined by considering the emissions that would have occurred anyway, in the absence of a dam.

The following GHG emission rates were used in comparing options: 7 kt eq. CO_2/TWh for best sites and 30 for the La Grande complex, with large reservoirs per unit of energy. These are "gross" emissions, measured on boreal reservoirs. They clearly represent pessimistic estimates, because future definitions of "net" emissions will be much smaller.

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Author: *Luc Gagnon* gagnon.luc@hydro.qc.ca
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Hydro Québec

Ontario Waterpower Association

The *Real* Value of Waterpower

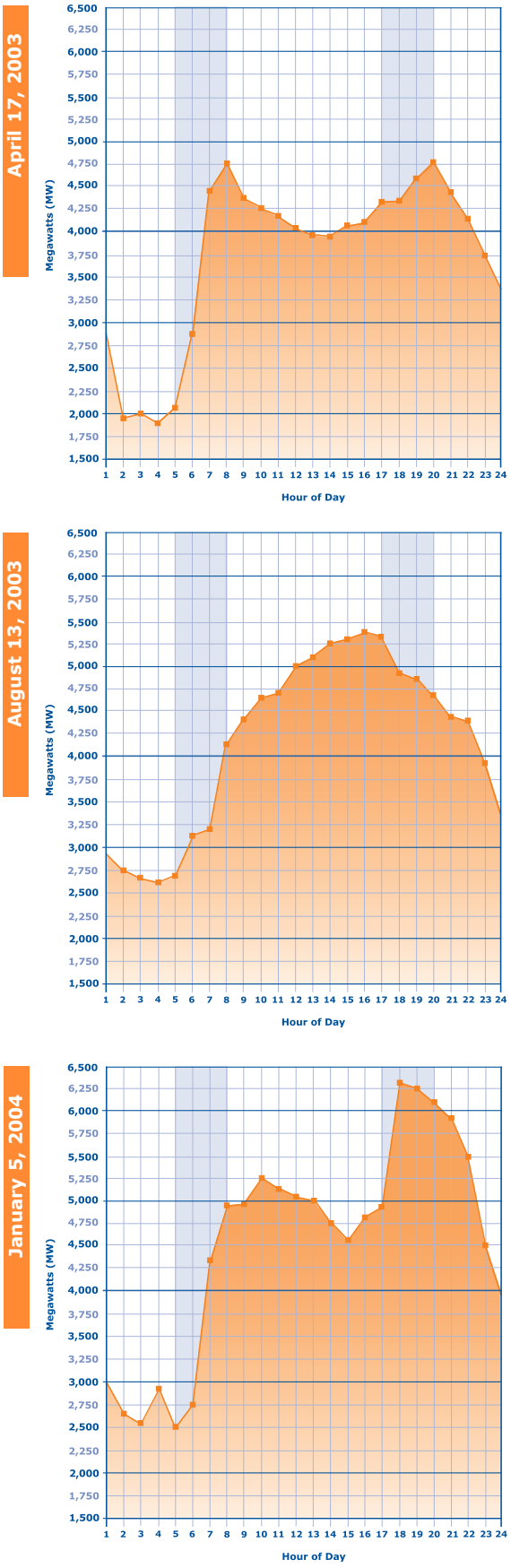
When we hear about the challenges facing the electricity sector these days, commentators normally focus on energy. When the term "supply" is used, the average person tends to think of electricity as a commodity, which we simply need more of.

The electricity system is much more complicated than that. Customers are using electricity at virtually the same time as it is being generated. The system operators at the Independent Market Operator (IMO) are charged with the task of matching the amount of generation on line at every instant in time, with the collective load requirements of everyone who is making steel, enjoying air conditioning or making toast.

Most dispatchable waterpower facilities are used every day to help ramp generation up quickly to match rapidly rising morning loads. Waterpower units are able to respond much more rapidly to changes in load than our other major generation sources; so they are used to compliment the attributes of the overall system mix. In short – all generation is not created equal – and waterpower's ability to follow load is provincially significant.

These three daily dispatch graphs show the profile of waterpower energy production:

- On **April 17, 2003** the system operators dispatched 2,500 MW of waterpower between 5:30 and 7:00 a.m. Waterpower was backed off somewhat through the day, and then ramped up again between 5:00 and 8:00 p.m. A similar profile takes place in the fall.
- The **August 13, 2003** graph reflects the difference in season, with peak loads handled by waterpower generation in the late afternoon, when air conditioning loads are highest. On a weekday in August, waterpower generation can vary between 2,600 MW and 5,400 MW.
- The **January 5, 2004** graph indicates the most dramatic shift in daily generation, from 2,500 MW in the wee hours of the morning up to 6,300 MW in the early evening.

The real value of waterpower to the provincial system is its flexibility – its owner's ability to store water and vary flows quickly to respond to system needs. ■

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